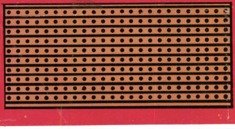
Easy to build projects for everyone

OCT. 81

12BS1.20

Everyday ELECTRONICS

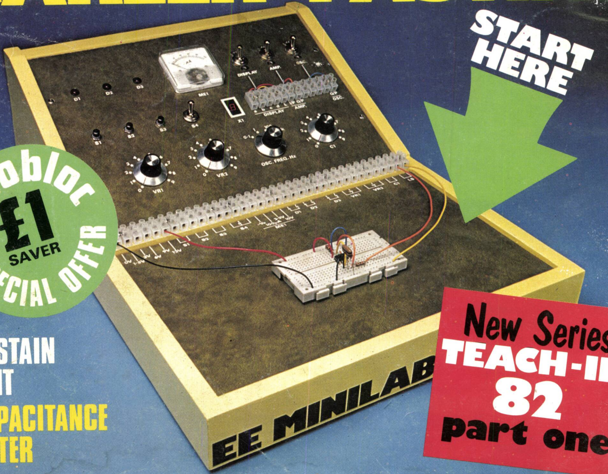
* FREE *



AND INSIDE A CHOICE OF DESIGNS TO BUILD ON THIS STRIPBOARD

CAREER or PASTIME

START HERE



veroblok £1 SAVER SPECIAL OFFER

New Series TEACH-IN 82 part one

SUSTAIN UNIT

CAPACITANCE METER

Australia $1·20 New Zealand $1·30 Malaysia $4·95 IR £1·00 (inc. V.A.T.)

LONDON'S TEST EQUIPMENT CENTRES

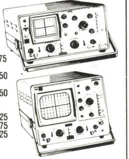
AUDIO ELECTRONICS

Retail • Mail Order • Industrial • Educational • Export

ALL MODELS ON DISPLAY
ALL PRICES INCLUDE VAT

OPEN SIX DAYS A WEEK • CALL IN AND SEE FOR YOURSELF

CROTECH OSCILLOSCOPES

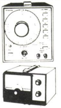


Range of Portable Scopes mains and battery operated. Plus special features (UK c/p **£3.00**)

3030 Single trace 15 MHZ, 5 mV, 0.5 micro secs. Plus built in component tester, 95mm tube	£166.75
3131 Dual trace 15 MHZ, trig to 35 MHZ, 5mV, 0.5 micro sec, 130mm tube, plus component tester.	£264.50
3034 Battery-mains dual trace 15 MHZ, trig to 20 MHZ, built in Nicads, 5mV, 0.5 micro secs. (Eliminator charger optional **£28.75**)	£356.50
Also Available 3033, single trace 3034	£293.25
3035, 130mm 3030	£189.75
3337, dual 30 MHZ, 130mm	£408.25

(Optional Probes all models – see below).

RF AND AUDIO SIGNAL GENERATORS



Mains operated (UK c/p **£1.00**)

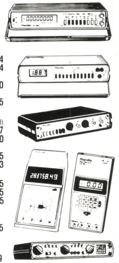
Audio 20 HZ-200 KHZ 4 band. Sine/Square o/p.

TE22D Distortion max 1%	£63.00
LAG26 Distortion 0.5-1% leader	£73.70
AG202A Distortion 0.5-1% Trio	£78.20
AG203 10 HZ-1 MHZ 5 band max distortion 0.1% Trio	£126.50

RF All feature Int/Ext. MOD. Variable output

TE20D 100 KHZ-100 MHZ 6 band (300 MHZ harmonics)	£52.00
LSG16 100 KHZ-100 MHZ 6 band (300 MHZ harmonics) Leader	£63.25
SG402 100 KHZ-30 MHZ 6 band professional trio	£68.00

THANDAR – SINCLAIR



Reliable low cost portable instruments, bench models all 25.5 x 15 x 5cm. Generators mains operated rest battery (supplied). UK c/p Hand models 65p, bench **£1.15**)

DIGITAL MULTIMETERS (3½ digit LCD)

TM354 Hand held, DC 2A, 2m ohm, 1mV – 1000V DC, 500v AC.	£45.94
TM352 Hand held, DC 10A, Hfe test. Continuity test	£57.44
TM353 Bench, 2A AC/DC, 1000V AC/DC, 20M ohm. Typical 0.25%	£96.60
TM351 Bench, 10A AC/DC, 1000V AC/DC, 20M ohm Typical 0.1%	£113.85

FREQUENCY COUNTERS (8 Digit)

PFM200 Hand held LED, 200 MHZ, 10mV (600 MHZ with TP600)	£57.27
TF040 Bench LCD, 40 MHZ, 40mV (400 MHZ with TP600)	£126.50
TF200 Bench LCD, 200 MHZ, 10-30mV (600 MHZ with (TP600)	£166.75
TP600 600 MHZ ÷ 10 Prescaler 10 mV	£43.13

GENERATORS (All bench models) mains operated

TG100 Function, 1 HZ-100 KHZ, Sine/SQ/Triangle/TTL	£90.85
TG102 Function, 0.2 HZ-2 MHZ, Sine/SQ/Triangle/TTL	£166.75
TG105 Pulse, 5 MHZ-5HZ (200nS-200mS) various outputs	£97.75

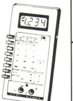
OSCILLOSCOPE (Bench model low power portable) 10 MHZ 2" trace, 10mV, 0.1 micro sec. All facilities. Model SC110 — £159.85

(Rechargable battery pack **£8.63**, AC adaptor/charger **£5.69**

OPTIONAL ITEMS

Carry case (bench only) **£6.84** AC Adaptors (state model) **£5.69**

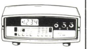
SABTRONICS EQUIPMENT



New reliable range of DMM's and frequency computers with those extra facilities and competitive prices. All battery operated (supplied). Except 5020A mains. Optional mains eliminators available.

8 DIGIT COUNTERS 0.1 HZ to 10 HZ Res. 10mV sensitivity to 100 MHZ (UK c/p **£1.00**)

8110A 20 HZ-100 MHZ in 2 ranges	£95.45
8610A 20 HZ-600 MHZ in 3 ranges	£113.85



9 DIGIT COUNTERS 30mV sensitivty to 1GHZ. Resolution 0.1 HZ-10 HZ

8610B 10 HZ-600 MHZ in 3 ranges.	£125.35
8000B 10 HZ-1GHZ in 3 ranges	£184.00

FUNCTION GENERATOR (UK c/p **£1.00**) with mains adaptor

5020A 1 HZ-200 KHZ Sine/Square/Triangle/TTC Freq. sweep. Low distortion	£98.90

DIGITAL MULTIMETERS Two LCD hand held – one with temperature range. Also LCD and LED Bench models.

2035A 3½ digit LCD hand. 2A AC/DC 20Meg ohm ETC	£95.45
2037A As 2035A with –50°C to + 150°C Temp. range 0.1° resolution	£109.25
2010A 3½ Digit LED. Auto decimal & minus. 10A AC/DC: 20Meg ohm etc.	£95.45
2015A LCD version of above.	£109.25

(c/p 2035/37A 65p: All others **£1.00**)

Options Touch & hold Probe for DMM's	£14.95
Battery eliminators (state model)	£5.69

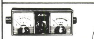
POWER SUPPLIES

13.8 volt. Output regulated mains operated (c/p **£1.00**)

3 to 5 amp	£15.50
5 to 8 amp	£17.95

ALSO STOCKED

Further range of low cost equipment Plus tools, accessories etc. Also special offers which vary from time to time for callers.



AMATEUR/CB

KDM6 1.5 to 250 MHZ Dip meter, 6 ranges	£38.50
SWR9 3-150 MHZ SWR + F/S	£9.50
SWR50 Twin meter SWR + Power 1KW max.	£13.95
310 Single meter SWR + Power 10W	£8.95
110 SWR/Power/FS-10/100W	£11.95
171 As '110' Twin meter	£14.50
175 SWR/FS/AE Match (40 MHZ)	£13.80
176 As '175' + 0/5/50 Watt power	£16.95
178 As '175' + 0/10/100W + MOD Scale	£19.50
HM20 SWR meter Plus 20K/Volt 19 range Multimeter	£28.95

(Note: SWR-Power ETC to 144/150 MHZ)

Just a selection of a huge range in stock – send for latest lists including professional ranges.

VARIABLE REGULATED POWER SUPPLIES

Mains operated regulated single metre (UK c/p **£1.50**)

241 0/12-0/24V 1 amp	£35.00
154 5-15 volt 3 amp	£44.00
423 0/12-0/24V 3 amp	£54.00

LCD DIGITAL MULTIMETRES SPECIAL PURCHASE – LIMITED PERIOD ONLY

6220 Reliable 22 range hand held 3½ digit LCD with volt/ohms auto range, unit and range signs, 10 amp AC/DC, battery warning, lower power ohms range; **Model 6110** Also has range hold, continuity buzzer and improved accuracy. All models high quality rotary operation. Resolution 0.1 milli volt: 10-Micro amp: 0.1 ohm.

6220 1000v DC: 0.2/10A AC/DC: 600v AC: 2meg ohm. Was **£55.95**

NOW £42.95

6110 As above plus 20mA AC/DC and improved accuracy. Was **£85.95**

NOW £59.95

THIS SPECIAL OFFER IS QUALITY WITH VALUE

Also in stock.

6200 20/200mA version of 6220 (i.e. no 10 amp)	£37.95
6100 0.2A version of 6110 (i.e. no 10 amp)	£49.95
188m 16 range with Hfe checker	£43.50
189m 30 range with Hfe checker	£69.95

MULTIMETERS

(UK c/p 65p or £1.00 for two)

CHOOSE FROM UK'S LARGEST RANGE

KRT101 10 range pocket 1K/Volt	£4.50
KRT100 12 range pocket 1K/Volt	£5.50
NH55 10 range pocket 2K/Volt	£6.50
AT1 12 range pocket Deluxe 2K/Volt	£7.75
ST5 11 range pocket 4K/Volt	£8.50
NH56 22 range pocket 20K/Volt	£11.50
YN360TR 19 range plus Hfe Test 20K/Volt	£13.50
ST303TR 21 range plus Hfe Test 20K/Volt	£15.95
KRT5001 16 range – range double 50K/Volt	£16.50
AT1020 19 range Deluxe plus Hfe Test 20K/Volt	£16.95
ETC5000 As KRT5001 plus colour scales 50K/Volt	£17.95
7081 18 range – range double 10A DC 50K/Volt	£20.85
TMK500 23 range. Plus 12A DC Plus Cont. Buzzer 30K/Volt	£22.75
AT205 21 range Deluxe 10A DC 50K/Volt	£25.75
C7080 26 range large scale 10A DC. 5KV AC/DC 20K/Volt	£27.50
AT210 23 range Deluxe 12A AC/DC 100K/Volt	£31.00
360TR 23 range Large scale 10A AC/DC Hfe Test 50Meg ohm. 1KV AC/DC 100K/Volt	£34.95

DIRECT READ HV PROBE

(UK c/p 65p)

0/40KV: 20K Volt £18.40

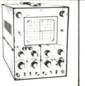
DISCOUNTS

Available for UK and Export for small and large quantities For most products. Please enquire.

OSCILLOSCOPE PROBE KITS

(UK c/p **50p** per 1 to 3) Available BNC plug or Banana X1 **£8.50**: X10 **£10.50**: X1-X10 **£12.95** Also X100 (BNC only) **£16.95**

SAFGAN PORTABLE OSCILLOSCOPES

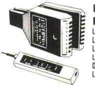


Range of low cost Dual Trace Scopes mains operated. Made in UK to exacting standards. Available as 10 MHZ: 15 MHZ or 20 MHZ. All feature 5mV sensitivity: 0.5 micro sec: 6.4 x 8cm display. (UK c/p **£2.50**)

DT410 Dual 10 MHZ	£194.35
DT415 Dual 14 MHZ	£201.25
DT420 Dual 20 MHZ	£216.20

Optional probes available (see Hameg above)

LOGIC PROBES/MONITORS/PULSERS circuit powered



(UK c/p **60p**)

LP1 DTL/TTL/CMOS. 10 MHZ: Pulse: Memory	£35.50
LP2 DTL/TTL/CMOS. 1.5 MHZ: Pulse:	£19.95
LP3 DTL/TTL/CMOS. 50 MHZ: Pulse: Memory	£55.95
LM1 Logic monitor for 8 to 16 pin IC's	£33.00
DP1 Digital pulser. Single or 100pps.	£58.50
LDP076 50 MHZ: 10Meg ohm: Logic Probe, with case	£56.90

ALL PRICES INCLUDE VAT

AUDIO ELECTRONICS

Cubegate Limited

301 EDGWARE ROAD, LONDON, W2 1BN, ENGLAND. TELEPHONE 01-724 3564
ALSO AT HENRYS RADIO, 404/406 EDGWARE ROAD, LONDON W2

OPEN SIX DAYS A WEEK • CALL IN AND SEE FOR YOURSELF

Order by Post with CHEQUES/ACCESS/VISA or Telephone your order

FREE CATALOGUE!
Send large SAE
(20p UK)
Schools, Companies, etc. free on request.

WATFORD ELECTRONICS

35 CARDIFF ROAD, WATFORD, HERTS., ENGLAND
MAIL ORDER, CALLERS WELCOME. Tel. Watford 40588/9

ALL DEVICES BRAND NEW, FULL SPEC. AND FULLY GUARANTEED ORDERS DESPATCHED BY RETURN OF POST. TERMS OF BUSINESS: CASH/CHEQUE/P.O.s OR BANKERS DRAFT WITH ORDER. GOVERNMENT AND EDUCATIONAL INSTITUTIONS' OFFICIAL ORDERS ACCEPTED. TRADE AND EXPORT INQUIRY WELCOME. P&P ADD 50p TO ALL ORDERS UNDER £10·00. OVERSEAS ORDERS POSTAGE AT COST. AIR/SURFACE. (ACCESS orders by telephone welcome).

VAT Export orders no V.A.T. Applicable to U.K. Customers only. Unless stated otherwise all prices are exclusive of V.A.T. Please add 15% to total cost including P & P.

We stock many more items. It pays to visit us. We are situated behind Watford Football Ground. Nearest Underground/BR Station: Watford High Street. Open Monday to Saturday 9.00 am–6.00 pm. Ample Free Car Parking space available.

POLYESTER CAPACITORS: Axial lead type (Values are in nF)
400V: 1nF, 1n5, 2n2, 3n3, 4n7, 6n8 **11p**; 10n, 15n, 18n, 22n **12p**; 33n, 47n, 68n **16p**; 100n, 150n **20p**; 220n **30p**; 330n **42p**; 470n **52p**; 680n **60p**; 1µF **68p**; 2µ2 **82p**; 4µ7 **85p**.
160V: 10nF, 12n, 100n **11p**; 150n, 220n **17p**; 330n, 470n **30p**; 680n **38p**; 1µF **42p**; 1µ5 **45p**; 2µ2 **48p**; 4µ7 **58p**.

POLYESTER RADIAL LEAD CAPACITORS (250V)
10nF, 15n, 22n, 27n **6p**; 33n, 47n, 68n, 100n **7p**; 150n, 220n **10p**; 330n, 470n **17p**; 680n **19p**; 1µF **23p**; 1µ5 **40p**; 2µ2 **46p**.

Teach-in 81 all parts available.

ELECTROLYTIC CAPACITORS: (Values are in µF) **500V:** 10 **52p**; 47 **78p**; **63V:** 0·47, 1·0, 1·5, 2·2, 3·3 **8p**; 4·7 **9p**; 6·8, 10 **10p**; 15, 22 **12p**; 33 **15p**; 47 **12p**; 100 **19p**; 1000 **70p**. **50V:** 47 **12p**; 68 **20p**; 220 **24p**; 470 **32p**; 2200 **90p**. **40V:** 4·7, 15, 22 **9p**; 3300 **90p**; 4700 **120p**. **25V:** 1·5, 6·8, 10, 22 **8p**; 33 **9p**; 47 **8p**; 100 **11p**; 150 **12p**; 220 **15p**; 330 **22p**; 470 **25p**; 680, 1000 **34p**; 2200 **50p**; 3300 **76p**; 4700 **92p**. **16V:** 40, 47, 100 **9p**; 125 **12p**; 220 **13p**; 470 **20p**; 680 **34p**; 1000 **27p**; 1500 **31p**; 2200 **36p**; 3300 **74p**; 4700 **79p**.
TAG-END TYPE: 70V: 4700µ **245p**. **64V:** 3300 **198p**; 2200 **139p**. **50V:** 3300 **154p**; 2200 **110p**. **40V:** 4700µ **160p**. **25V:** 4000 **92p**; 3300 **98p**; 2500, 2200 **90p**. 15,000 **345p**

TANTALUM Bead Capacitors
35V: 0·1µ, 0·22, 0·33 **15p**; 0·47, 0·68, 1·0, 1·5 **16p**; 2·2, 3·3 **18p**; 4·7, 6·8 **22p**; 10 **28p**. **16V:** 2·2, 3·3 **16p**; 4·7, 6·8, 10 **18p**; 15 **36p**; 22 **30p**; 33, 47 **40p**; 100 **75p**. **10V:** 15, 22 **26p**; 33, 47 **35p**; 100 **55p**.

MYLAR FILM CAPACITORS
100V: 1nF, 2n, 4n, 4n7, 10n **6p**; 15nF, 22n, 30n, 40n, 47n **7p**; 56n, 100n, 200n **9p**. 470n/**50V 12p**.

MINIATURE TYPE TRIMMERS
4-6pF, 2-10pF **22p**; 2-25pF, 5-65pF **30p**; 10-88pF **35p**.

COMPRESSION TRIMMERS
3-40pF, 10-80pF **20p**; 20-250pF **28p**; 100-580pF **39p**; 400-1250pF **48p**.

POLYSTYRENE CAPACITORS
10pF to 1nF **8p**; 1·5nF to 12nF **10p**.

SILVER MICA: 2pF, 3·3, 4 7, 6·8, 8·2, 10, 12, 15, 18, 22, 27, 33, 39, 47, 50, 56, 68, 75, 82, 85, 100, 120, 150, 180 **15p**. 200, 220, 250, 270, 300, 330, 360, 390, 470, 600, 800, 820 **21p**. 1000, 1200, 1800, 2000 **30p**. 3300, 4700 **60p**.

CERAMIC CAPACITORS: 50V
0·5pF to 10nF **4p**; 22n to 100n **7p**.

EURO BREADBOARD £5·20.

POTENTIOMETERS: (ROTARY)
Carbon Track. 0·25W Log & 0·5W Linear Value.

500 Ω, 1 K & 2K (Lin. only) Single	29p
5K-2 M Ω single gang	29p
5K-2 M Ω single with DP switch	78p
5K-2 M Ω double gang	88p

SLIDER POTENTIOMETER
0·25W log and linear values 60mm

5K Ω-500K Ω single gang	70p
10K Ω-500K Ω dual gang	110p
Self Stick Graduated Bezels	36p

PRESET POTENTIOMETERS
Vertical & Horizontal

0-1W 50 Ω—5M Ω Miniature	7p
0-25W 100 Ω—3·3M Ω Horiz	10p
0-25W 200 Ω—4·7M Ω Vert	10p

RESISTORS: Carbon Film, High Stability, Low Noise, Miniature Tolerance 5%.

Range	Val.	1–99	100+
¼W 2Ω2–4M7	E24	2p	1p
½W 2Ω2–4M7	E12	2p	1p
1W 2Ω2–10M	E12	5p	4p
2% Metal Film 10Ω–1M		6p	4p
1% Metal Film 51Ω–1M		8p	6p

100+ price applies to Resistors of each value not mixed.

TGS 812 or 813 gas and smoke detector **575p**. Socket for above **40p**.

OPTO ELECTRONICS
LEDs plus clips

TIL209 Red	13
TIL211 Grn	18
TIL212 Yellow	18
·2" Red	14
2" Yellow Green	18
Square LED	29
OCP71	120
ORP12	80
ORP61	85
2N5777	45

7 Seg Displays

TIL321 C An ·5"	115
TIL322 C Cth ·5"	115
DL704 C Cth ·3"	99
DL707 C.A. ·3"	99
DL747 C.A. ·6"	180
FND357 or 500	120
MAN3640	175
·3" Green C.A.	180
TIL32 Inf. Red	52
TIL78 detector	54
Bargraph Red. Ten segment	225p

LCD DISPLAYS

3½ Digit	599p
4 Digit	750p
6 Digit	850p

VOLTAGE REGULATORS*

1A	TO3	+ve	—ve	
5V	7805	145p	7905	220p
12V	7812	145p	7912	220p
15V	7815	145p	7915	220p
18V	7818	145p	—	
1A	TO220 Plastic Casing			
5V	7805	50p	7905	55p
12V	7812	50p	7912	55p
15V	7815	50p	7915	55p
18V	7818	50p	7918	55p
24V	7824	50p	7924	55p
100mA	TO92 Plastic Casing			
5V	78L05	30p	79L05	60p
6V	78L62	30p	—	
8V	78L82	30p	—	
12V	78L12	30p	79L12	60p
15V	78L15	30p	79L15	60p

CA3085	95	LM326N	240	78H05+5V/5A	550
LM300H	170	LM327N	270		
LM305H	140	LM723	35	78HG 5A +5V to +25V	600
LM309K	135	TAA550	50		
LM317K	350	TBA625B	75	79HG 5A −2·25 to −24V	850p
LM323K	625	TDA1412	150		

SLIDE 250V:

1A DPDT	14p
1A DP c/off.	15p
½A DPDT	13p

PUSH BUTTON
Latching or Momentary.

SPST C/Over	99p
DPDT C/Over	145p

SWITCHES
TOGGLE 2A 250V

SPST	33p
DPDT	44p

SUB-MIN TOGGLE

SP changeover	59p
SPST on/off	54p
DPDT 6 tags	75p
DPDT c/off	88p
DPDT Biased	145p

SWITCHES Miniature Non-Locking
Push to Make **15p** Push to Break **20p**
ROCKER: SPST on/off 10A 250V **28p**
ROCKER: Illuminated DPST Lights when on: 10A 240V **85p**
ROTARY: (ADJUSTABLE STOP) 1 pole/2-12 way 2p/2-6W, 3p/2-4W, 4p/2-3W. **45p**
ROTARY: Mains 250V AC, 4 Amp **56p**

DIL SOCKETS (Low Profile – Texas)
8 pin **8p**; 14 pin **10p**; 16 pin **10p**; 18 pin **16p**; 20 pin **22p**; 24 pin **25p**; 28 pin **28p**; 40 pin **30p**.

JACKSONS VARIABLE CAPACITORS

Dilicon 100/300pF	205p
500pF	250p
6 1 Ball Drive 4511/DAF	160p
Dial Drive 4103 6 1/36 1	775p
Drum 54mm	59p
0-1·365pF	325p
00 2 365pF	395p
0 2 365pF with slow motion Drive	450p
00 208/176	395p
,, ,, with slow motion drive	450p
C804-5pF 10 15 25 50 pF	278p
100, 150pF	352p
'L' 3 x 310pF	725p
00·3 x 25pF	550p

DENCO COILS

'DP' VALVE TYPE Range 1 to 5 Bl., Rd., Yl. Wht.	122p
6–7 B.Y.R.	110p
1·5 Green	150p
'T' 1 to 5 Bl., Yl., Rd., Wht.	150p
B9A Valve Holder	42p
RDT2	145p
RFC 5	140p
RFC 7 (19mH)	160p
IFT 13; 14; 15; 16; 17	120p
IFT 18/1·6	135p
IFT 18/465	152p
TOC 1	125p
MW5FR	122p
MW/LW 5FR	154p

VEROBOARDS ·1"

	clad	plain
2½ × 3¾"	73p	52p
2½ × 5"	83p	—
3¾ × 3¾"	83p	—
3¾ × 5"	95p	79p
3¾ × 17"	326p	211p
4¾ × 17"	426p	—
Pkt. of 100 pins	50p	
Spot Face Cutter	118p	
Pin Insertion Tool	162p	

COPPER clad boards
Fibreglass

6 × 6"	90p
6 × 12"	150p
S.R.B.P. 9·5 × 8	95p
Ferric Chloride 1 lb. Anhydr.	195p
Dalo Pen	90p

DIODES

AA129	22
BA100	15
BY126	12
BY127	12
CRO33	250
OA9	40
OA47	12
OA70	12
OA79	15
OA81	15
OA85	15
OA90	8
OA91	8
OA95	8
OA200	8
OA202	8
IN914	4
IN916	5
IN4001/2	5
IN4003	6
IN4004/5	6
IN4006/7	7
IN4148	4
IS44	9
3A/100V	15
3A/400V	16
3A/600V	17
3A/1000V	30
6A/400V	50p

We stock a wide selection of Electronic Books and Magazines

ZENERS
Range 2V7 to 39V 400mW **8p each**
Range 3V3 to 33V. 1·3W **15p each**

NOISE
Diode **195**

BRIDGE RECTIFIERS
(plastic case)

1A/50V	20
1A/100V	22
1A/200V	25
1A/400V	29
1A/600V	34
2A/50V	35
2A/200V	40
2A/400V	46
2A/600V	65
6A/100V	83
6A/400V	95
10A/200V	215
10A/600V	315
25A/200V	215
25A/600V	395
BY164	56
VM18 DIL	55

DIAC
ST2 **25**

SCRs Thyristors

1A/100V	42
5A/400V	40
5A/600V	48
8A/300V	60
8A/400V	75
8A/600V	95
12A/400V	95
12A/800V	188
15A/700V	180
2N4444	140
2N5062	32
2N5064	35
BT106	150
C106D	38
TIC44	24
TIC45	29

TRIACS

3A/100V	48
3A/400V	56
8A/100V	60
8A/400V	69
8A/800V	115
12A/100V	78
12A/400V	82
12A/800V	135
16A/100V	103
16A/400V	105
25A/400V	185
25A/800V	295
25A/1000V	480
30A/400V	525
T28000D	120

TTL 74 (TEXAS)

7400	11
7401	11
7402	11
7403	14
7404	14
7405	18
7406	28
7407	28
7408	16
7409	16
7410	14
7411	20
7412	20
7413	24
7414	32
7416	25
7417	25
7420	16
7421	20
7422	20
7423	22
7425	28
7426	30
7427	27
7428	28
7430	16
7432	26
7433	27
7437	27
7438	27
7440	17
7441	68
7442	38
7443	90
7444	90
7445	65
7446	55
7447	50
7448	50
7450	16
7451	16
7453	16
7454	16
7460	16
7470	35
7472	30
7473	30
7474	25
7475	40
7476	30
7480	48
7481	120
7482	70
7483	50
7484	80
7485	95
7486	26
7489	205
7490	28
7491	45
7492	30
7493	30
7494	34
7495	50
7496	45
7497	120
74100	85
74104	54
74105	55
74107	32
74109	35
74110	40
74111	55
74112	170
74116	88
74118	80
74119	90
74120	75
74121	30
74122	45
74123	50
74125	42
74126	40
74128	42
74132	48
74136	35
74141	70
74142	190
74143	250
74144	250
74145	70
74147	99
74148	75
74150	80
74151	45
74153	45
74154	75
74155	75
74156	75
74157	45
74159	99
74160	60
74161	60
74162	62
74163	64
74164	64
74165	62
74166	65
74167	185
74170	168
74172	290
74173	65
74174	72
74175	72
74176	55
74177	75
74178	95
74179	68
74180	65
74181	140
74182	75
74184	99
74185	99
74188	290
74190	70
74191	70
74192	70
74193	65
74194	75
74195	65
74196	65
74197	65

74LS

LS00	12
LS01	13
LS02	14
LS03	14
LS04	15
LS05	15
LS06	15
LS09	15
LS10	15
LS11	15
LS12	15
LS13	30
LS14	48
LS15	15
LS20	15
LS21	15
LS22	15
LS26	18
LS27	15
LS28	20
LS30	18
LS32	15
LS33	16
LS37	16
LS38	16
LS40	16
LS42	35
LS47	40
LS51	15
LS54	15
LS55	30
LS73	25
LS74	25
LS75	28
LS76	20
LS78	24
LS83	50
LS85	70
LS86	38
LS90	35
LS91	80
LS92	36
LS93	36
LS95	45
LS96	120
LS107	43
LS109	30
LS112	30
LS113	40
LS114	35
LS122	44
LS123	55
LS124	105
LS125	30
LS126	30
LS132	45
LS136	28
LS138	35
LS139	38
LS151	39
LS153	39
LS155	39
LS156	39
LS157	35
LS158	36
LS160	41
LS161	41
LS162	41
LS163	41
LS164	48
LS165	145
LS166	85
LS170	170
LS173	72
LS174	72
LS175	58
LS181	130
LS183	275
LS191	58
LS192	58
LS193	65
LS194	40
LS195	40
LS196	58
LS197	85
LS200	345
LS221	60
LS240	96
LS243	85
LS243	85
LS244	80
LS245	118
LS251	40
LS253	40
LS257	48
LS258	40
LS259	85
LS261	195
LS266	25
LS273	90
LS279	88
LS280	250
LS283	45
LS290	57
LS293	46
LS295	215
LS298	130
LS299	420
LS323	270
LS365	37
LS366	37
LS367	37
LS368	90
LS373	75
LS374	75
LS375	48
LS377	90
LS378	69
LS390	140
LS393	140
LS399	230
LS668	105

CMOS

4000	14
4001	14
4002	14
4006	66
4007	18
4008	62
4009	35
4010	40
4011	15
4012	18
4013	34
4014	75
4015	66
4016	32
4017	48
4018	88
4019	42
4020	61
4021	70
4022	66
4023	20
4024	45
4025	19
4026	130
4027	38
4028	58
4029	77
4030	50
4031	170
4032	125
4034	195
4035	95
4036	275
4037	115
4038	110
4039	290
4040	59
4041	78
4042	60
4043	70
4044	65
4046	75
4047	75
4048	55
4049	30
4050	30
4015	78
4052	78
4053	78
4054	125
4055	125
4056	120
4058	480
4060	90
4063	99
4066	36
4067	399
4068	22
4069	20
4070	26
4071	20
4072	20
4073	20
4075	20
4076	60
4081	26
4082	21
4085	65
4086	70
4089	140
4093	43
4094	168
4095	90
4096	90
4097	320
4098	88
4099	95
4161	99
4410	725
4411	695
4412	800
4433	770
4501	28
4502	90
4503	50
4507	40
4508	265
4510	68
4511	68
4512	75
4514	195
4515	195
4561	75
4518	42
4519	29
4520	78

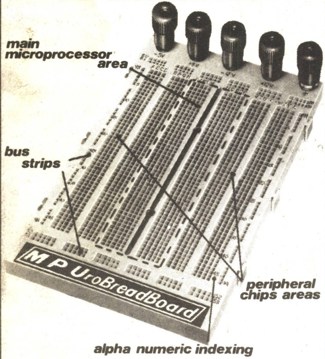
LINEAR IC's

702	75
709C 8 pin	35
710*	48
733	75
741 8 pin	14
747C 14 pin	78
748C 8 pin	36
753 8 pin	185
810	159
2114L-300N	99
2114L-200	130
2114-450N	99
4116-200N	99
2708	225
2716-5V	250
9400CJ	350
AY-1-0212	675
AY-1-1313A	660
AY-1-1320	225
AY-1-5050	99
AY-1-5051	160
AY-3-1270	840
AY-3-8500	390
AY-3-8910	720
AY-5-1224A	235
AY-5-1230	450
AY-5-1317A	639
CA3011	110
CA3012	175
CA3014	157
CA3018	68
CA3019	70
CA3020	186
CA3023	191
CA3028A	80
CA3035	235
CA3036	115
CA3043	275
CA3045	365
CA3046	71
CA3048	214
CA3059	195
CA3075	213
CA3080E	65
CA3081	190
CA3089E	215
CA3090AQ	375
CA3123	150
CA3130	90
CA3140	48
CA3160	95
ICL7106	795
ICL7107	975
ICL8038CC	340
ICM7205	1150
ICM7207	475
ICM7215	1050
ICM7216A	1950
ICM7217A	790
ICM7224	785
ICM7555	80
LD130	452
LF351	48
LF356	85
LM10	395
LM301A	26
LM308T	95
LM311H	70
LM318	240
LM324	50
LM339	70
LM348	90
LM349	125
LM358	50
LM379	375
LM380	80
LM381N	145
LM382	125
LM384	140
LM386	99
LM387	120
LM389	99
LM1458	[illegible]
LM2917	195
LM3900	60
LM3909N	70
LM3911	125
LM3914	220
LM3915	220
LM3916	240
LM13600	135
M252AA	[illegible]
M253AA	1150
MC1303	88
MC1304P	260
MC1310P	150
MC1488	75
MC1489	75
MC1494	694
MC1495	350
MC1496L	92
MC1596	[illegible]
MC1709	[illegible]
MC3302	150
MC3340	120
MC3360	120
MC3401	52
MC3403	89
MC3405	150
MCF6040	97
MK50398	635
MM5303	635
MM5387A	576
NE529	225
NE543	210
NE544	185
NE555	16
NE556	55
NE560	325
NE561	395
NE562	410
NE564	435
NE565	17
NE566	180
NE567	170
NE570	450
NE571	420
RC4136D	40
S566B	245
SAB3209	425
SAB3210	275
SG3402	295
SN76013	170
SN76023N	170
SN76477	175
SP8629	299
TAA621	250
TAD100	159
TBA120	70
TBA550Q	330
TBA641	250
TBA651	190
TBA800	90
TBA810	95
TBA820	70
TDA1004	290
TDA1008	316
TDA1022	575
TDA1024	105
TDA2020	320
TDA2030	300
TL061CP	48
TL064	159
TL071CP	40
TL074CN	140
TL081CP	42
TL083CN	92
TL084CN	105
UAA170	170
UAA1003	935
XR2206	320
Z80CPU	400
ZN414	95
ZN423	195
ZN424	130
ZN1034	200
ZN425E	350
ZN426E	300
ZN1040E	685

Transistors

AC125	35
AC126/7	25
AC128	25
AC141/2	30
AC176	28
ACY17/18	70
ACY19/20	75
ACY21/22	75
ACY28	75
ACY39	85
AD149	79
AD161/2	42
AF118	95
AF139	40
AF178	75
AF239	78
BC107	10
BC107B	12
BC108	10
BC108B	12
BC108C	12
BC109	10
BC109B	12
BC109C	12
BC140	30
BC142/3	30
BC147	9
BC147B	10
BC148	9
BC148B	10
BC148C	10
BC149	9
BC149C	10
BC153/4	27
BC157/8	10
BC159	11
BC160	45
BC167	10
BC168C	10
BC169C	10
BC170	15
BC172/3	11
BC177/8	120
BC179/81	20
BC182/3	10
BC184	10
BC182L	10
BC183L	10
BC184L	10
BC187	26
BC212	10
BC212L	10
BC213	10
BC213L	10
BC214	10
BC214L	10
BC236	10
BC237	14
BC307B	15
BC308B	16
BC327	15
BC238	14
BC338	15
BC441	34
BC461	34
BC477	40
BC516/7	40
BC547/8	14
BC549C	14
BC557/8	15
BC559	15
BCY70/71	16
BCY72	20
BD131/2	48
BD133	60
BD135	45
BD136/7	40
BD138/9	40
BD140	40
BD144/5	198
BD205	110
BD214	115
BD245	198
BD378	70
BD434	55
BD517	75
BD695A	85
BD696A	85
BDY56	180
BF115	35
BF167	29
BF180	38
BF194/5	12
BF196/7	12
BF198	16
BF199	18
BF200	30
BF224	24
BF244/5	28
BF244B	30
BF256	35
BF257/8	32
BF259	35
BF274	42
BF336	40
BF451	35
BF594	30
BF595	39
BFR30/40	23
BFR41	23
BFR79	23
BFR80/81	24
BFR98	105
BFX29	28
BFX84	26
BFX85/86	28
BFX87/8	28
BFY50	23
BFY51/52	23
BFY56	32
BFY64	35
BFY81	120
BRY39	40
BSX20	20
BSY95A	25
BU105	170
BU205	190
BU208	200
E421	250
MD8001	250
MJ400	150
MJ491	175
MJ2955	90
MJE340	54
MJE370/71	100
MJE2955	99
MJE3055	70
MPF102	66
MPF103/104	36
MPF105	36
MPF106	40
MPSA05	25
MPSA06	25
MPSA12	32
MPSA55	30
MPSA56	30
MPSA70	25
MPSU06	55
OC26	170
OC28	130
OC35	125
OC36	120
OC41/42	120
OC43	55
OC44	120
OC45	40
OC70/71	40
OC72	40
OC74/75	50
OC76	50
OC81	50
OC82	130
OC83/84	40
OC140	110
OC170/1	85
OC200	85
TIP29	34
TIP29A	36
TIP29B	56
TIP29C	60
TIP30	48
TIP30C	56
TIP31A	45
TIP31C	55
TIP32A	48
TIP32C	60
TIP33A	65
TIP33C	78
TIP34A	74
TIP34C	88
TIP35A	160
TIP35C	185
TIP36A	170
TIP36C	199
TIP41A	60
TIP41B	68
TIP42A	60
TIP42B	75
TIP120	90
TIP121	99
TIP142	120
TIP147	120
TIP2955	60
TIP3055	60
TIS43	32
TIS44/45	45
TIS88A	50
TIS90	30
TIS91	32
ZTX107	11
ZTX109	12
ZTX109	11
ZTX300	13
ZTX301/2	16
ZTX303	25
ZTX304	17
ZTX314	25
ZTX326	30
ZTX341	30
ZTX500	14
ZTX501/502	15
ZTX503	18
ZTX504	25
ZTX531	25
ZTX550	25
2N697	23
2N698	40
2N699	35
2N706A	19
2N708	19
2N918	33
2N1131/2	24
2N1303	60
2N1304/5	85
2N1671B	215
2N2219A	28
2N2220A	26
2N2221A	25
2N2222A	25
2N2369A	17
2N2646	48
2N2904/5	28
2N2905A	26
2N2906/7	26
2N2926G	10
2N3053	26
2N3054	58
2N3055	48
2N3442	140
2N3663	15
2N3702/3	10
2N3704/5	10
2N3706/7	10
2N308/9	10
2N3710/1	10
2N3771	179
2N3772	195
2N3773	270
2N3819	22
2N3820	45
2N3822/3	65
2N3866	90
2N3903/4	[illegible]
2N3905	15
2N3906	17
2N4037	46
2N4058	10
2N4061/2	10
2N4427	80
2N3859	78
2N4871	55
2N5172	18
2N5179	45
2N5191	75
2N5305	24
2N547/8	36
2N5485	36
2N5642	750
2N5777	45
2N6027	32
2SA715	60
2SC495/6	[illegible]
2SC1096	[illegible]
2SC1173	125
2SC1306	150
2SC1307	220
2SC1449	85
2SC1678	140
2SC1923	50
2SC1945	225
2SC1953	90
2SC1957	90
2SC1969	198
2SC2028	85
2SC2029	180
2SC2078	155
2SC2091	85
2SC2314	85
2SC2166	165
[illegible]	190
[illegible]	75
3N128	112
3N140	112
40311	60
40313	125
40315	68
40316	85
40361/2	50
40408	95
40411	280
40467	95
40468	60
40594/5	90
40603	90
40673	95

If you're into MICROPROCESSORS then they should be into an M P UroBreadBoard



- MPU Section accepts 24, 28, 40 & 64 pin DIL microprocessors
- Auxiliary Areas accept any .3" or .6" RAM, ROM or peripheral chip
- Power Bus Strips on all sides
- 5 incoming turret Power Terminals
- Component Support Bracket included
- Over 1400 contact points
- Alpha-Numeric column and row indexing
- Eurocard size (160mm x 100mm)
- Slots onto all BIMBOARDS
- Non-Slip rubber backing
- Ideal for schools and colleges
- Long life, <10m.ohms, nickel silver contacts

The PROFESSIONALS breadboard that BEGINNERS can start on

BOSS *INDUSTRIAL MOULDINGS LTD*
2 Herne Hill Rd, London SE24 0AU, England
Telephone 01-737 2383 Telex 919693
Cables & Telegrams: LITZEN LONDON SE24

Please send me . . . . MPUroBreadBoard(s) @ £18.
This price includes VAT & PP, is applicable from Mar. 1, '81, but please add 15% for Overseas Orders, make cheques/P.O. payable to BOSS Industrial Mouldings Ltd and allow 10 days for order processing and cheque clearance etc.

I enclose a cheque/P.O. to the value of £..........................

Name . . . .
Company . . . .
Address . . . .
. . . .
. . . .
Telephone Number EE10

Rapid Electronics

HILLCROFT HOUSE, STATION ROAD, EYNSFORD, KENT.

COMPONENT KITS

¼W Resistor kit. Contains 10 of each value from 4·7 to 1M (650 resistors) **480p** each.
Ceramic Capacitor kit. Contains 5 of each value 22pF to 0·01uF (135 caps) **370p** each.
Polyester Capacitor kit. 5 or each value from 0·01 to 1μF (65 capacitors) **575p** each.
Nut and Bolt kit. Total 300 items. **140p.**

25 6BA ¼" bolts	25 4BA ¼" bolts
25 6BA ½" bolts	25 4BA ½" bolts
50 6BA washers	50 4BA washers
50 6BA nuts	50 4BA nuts

CAPACITORS

Polyester. Radial leads. C280 type. 0·01 0·015, 0·022, 0·033, **6p**; 0·047, 0·1, **7p**; 0·15, 0·22, **9p**; 0·33, 0·47, **13p**; 1·0μ **23p**
Electrolytic. Radial leads 1/63V, 2·2/63V, 4·7/63V, 10/25V, **7p**; 22/25V, 47/25V, **8p**; 100/25V, **9p**; 220/25V **14p**; 470/25V, **20p**; 1000/25V, **30p.**
Ceramic disc. Sold in packs of 5 per value. **22p-0·01μF. 15p** per pack

RESISTORS

Carbon film ¼W 5% 4·7Ω to 10M. Sold in packs of 10 per value. **10p** per pack. Preset Min. Hor. 100Ω to 1M. **7p** each. Rotary pots values available 5K-500K Log or Lin. ★**26p** each.

LINEAR

★741	15p	LM324	40p	★RC4136	70p
CA3080	70p	LM380	80p	SN76477	150p
★CA3130	75p	LM381	120p	★TL081	30p
★CA3140	45p	LM382	120p	★TL084	90p
*ICM7555	80p	LM387	120p	XR2206	300p
★ ICM7555	80p	LM1458	40p	ZN414	100p
LF351	45p	LM3900	50p	ZN425E	350p
LF356	90p	★LM3914	200p	TBA800	80p
LM301A	25p	★LM3915	200p		
		★NE555	80p		
		NE556	55p		

CONNECTORS

Jack	Plug	skt	DIN	Plug	skt
2·5mm	10p	10p	2 pin	9p	9p
3·5mm	10p	9p	3 pin	12p	10p
Stand'd	12p	20p	5 pin		
Stereo	24p	25p	180	13p	11p

LEDS

★3mm red	7p
★3mm green	12p
3mm yellow	14p
★5mm red	8p
★5mm green	12p
5mm yellow	14p
10 3 or 5mm LED clips	30p
FND500	70p

VEROBOARD

Size 0·1in Matrix	
2·5 × 1"	22p
2·5 × 3·75"	75p
2·5 × 5"	85p
3·75 × 5"	95p
Veropins per 100	
Single sided	50p
Double sided	60p

TRANSISTORS

AC128	25p	★BC182L	8p	BD140	35p
AC176	25p	★BC184L	7p	ZTX300	14p
AD161	40p	BC212L	10p	2N2646	45p
AD162	40p	★BC214L	8p	2N3053	23p
BC107	10p	BC547	10p	2N3055	50p
★BC108	8p	BD131	35p	★2N3702	6p
★BC108C	10p	BD132	35p	★2N3704	6p
BC109	10p	BD139	35p	★2N3905	6p

EXTENDED CATALOGUE

Our new extended 36 page Catalogue includes an even bigger range at competitive Prices. Send **42p** in stamps for your copy. FREE with orders over £5. Prices exclude VAT. Please add **50p** carriage on orders below £10.

HARDWARE

Antex 17W Soldering Iron	420p
Antex 25W Soldering Iron	440p
10m pack 22swg solder	60p
5 PP3 battery connectors	30p
Min push to make switch	12p
Min push to break switch	15p
64mm 64 ohm speaker	70p
20mm panel fuseholder	25p
Crystal earphone + plug	44p

★ *Same day despatch* ★ *Competitive prices*
★ *Top quality components* ★ *In-depth stock*

MIGHTY NINETY PACKS

SUPER VALUE PACKS ALL AT 90p EACH
POSTAGE 20p PER PACK UP TO FOUR PACKS
FIVE OR MORE POST FREE
BUY SIX PACKS AND GET A SEVENTH PACK FREE!

MN1. 300 ¼-watt Resistors pre-formed for P&C Mtg.
MN2. 200 ½, AND ¼-watt Resistors.
MN3. 100 1 & 2-watt Resistors.
MN4. 50 Wirewound Resistors.
MN5. 100 metal oxide Resistors. 1%, 2% and 5%.
MN6. 12 asstd. potentiometers.
MN7. 25 asstd. skeleton pre-set Resistors.
MN8. 50 asstd. Eletrolytic Capacitors.
MN9. 100 asstd. Ceramic Capacitors. Plte, disc, tub and monolytic etc.
MN10. 100 mixed capacitors. Polyester. Polystyrene. Metallised, Radial and Axial types.
MN11. 20 asstd. Silver Mica Capacitors.
MN12. 8 Tantalum Bead Capacitors (useful values).
MN13. 20 asstd. Transistors. BC, 2N Series + Power etc.
MN14. 40 IN4148 Diodes.
MN15. 5 Light Sensitive Devices.
MN16. 20 min. wire-ended Neons.
MN17. 2 12-volt Relays. Ex nearly new equip.
MN18. 3 Encapsulated Reed Relays. 9-12v. coil, d.-pole and t.-pole.
MN19. 2 24-volt Relays. Ex nearly new equip.
MN20. 1 240-110 to 12-volt, 100ma Transformer.
MN21. 1 240-110 to 24-volt 100ma Transformer.
MN22. 8 ·2" Led's with clips. 4 red, 2 yellow, 2 green.
MN23. 1lb asstd. screws, nuts, washers, self-tappers etc.
MN24. 100 asstd. small springs.
MN25. 50 asstd. pop rivets.
MN26. 50 assted. insulated crimps.
MN27. 200 items, grommets, spacers, cable markers, plastic screws, sleeving, tie wraps etc.
MN28. 20 asstd. fuses. 1¼" 20mm etc.
MN29. 75m equipment wire, asstd. colours and sizes.
MN30. 3 × 2m length, 3 core, mains cable.
MN31. 12 asstd. trimmer capacitors, compression film. Air-spaced etc.
MN32. 15 30pf Beehive trimmers.
MN33. 20 coil formers, ceramic, plastic, reed relay etc.
MN34. 25 min. glass reed switch.
MN35. 10 asstd. switches, toggle, slide, micro, etc.
MN37. 10 asstd. audio connectors. Din phono etc.
MN38. 1 PCB with triac control IC data inc.
MN39. 1 oscillator PCB loads of components (no data).
MN40. 50 Polystyrene Capacitors.
MN42. 10 BC107 Transistors.
MN43. 10 BC108 Transistors.
MN44. 10 screw fix S.P. C.O. min. slide switch.
MN45. 5 1·35V. 1,000 mA/H. Mercury batteries ⅝in diameter × ⅝in high.
MN58. 2 × CA 723 voltage regulator.
MN64. 5 press-to-make min. switches.
MN65. 3 BF 245-FETS.

PLEASE QUOTE NO. OF PACKS WHEN ORDERING

CHORDGATE LTD.

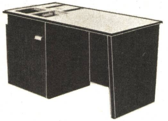
75 FARINGDON ROAD, SWINDON, WILTS.
Tel. Swindon (0793) 33877. Retail shop at above address.

NEW KITS THIS MONTH

COMBINATION SWITCH
Battery operated, would control solenoid lock or any electrical device up to 40 watts. Could be let into wall, virtually impossible to decode. Uses no power when in the off position. Complete kit **£4.50.**

A SECRET SWITCH
Can be hidden behind a panel, door, wallpaper, etc. etc. 2 reeds placed near enough to the surface to be magnetisable, the first reed closes a relay, the secondary contacts of which will light the lamp or whatever device is secretly controlled and it would also latch itself on. The second reed will unlatch the relay. Complete kit **£1.95.**

COMPUTER DESK



Size approx. 4'x 2' x 2'6" high. These were made for hard work, the top being formica covered. Suitable for housing instruments or for use as office desks. Beautifully made, these cost over £100 each, our price only £11.50 each, however, you must arrange to collect.

INSTRUMENT BOX WITH KEY

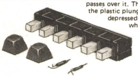
Very strongly made (ply-wood sides with hard board top and bottom). This is black grained effect, vinyl covered, very pleasing appearance. Internal dimensions 12½" long, 4½" wide, 6" deep. Ideal for carrying your multi range meter and small tools and for keeping them in a safe place. **£2.30.** Post paid if ordered with other goods, otherwise £1.00.

ROPE LIGHT

4 sets of coloured lamps in translucent plastic tube arranged to give the appearance of a running or travelling light. With variable speed control box, ideal for disco or shop window display. Complete, made up, ready to plug into mains. **£36.00 + £2** post.

COMPUTER KEY SWITCHES (make your own keyboard)

These are for making up on a p.c.b. and consist of a vertical mounting computer type reed switch, which makes circuit when a magnet passes over it. The magnet is located in the plastic plunger which in turn is depressed by a push rod, to which the legended top is fixed. These are made up in banks of 6, price **£2.30** per bank of 6 (including tops)

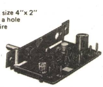


OUR CAR STARTER AND CHARGER KIT has no doubt saved many motorists from embarrassment in an emergency you can start car off mains or bring your battery up to full charge in a couple of hours. The kit comprises: 250w mains transformer, two 10 amp bridge rectifiers, start/charge switch and full instructions. You can assemble this in the evening, box it up or leave it on the shelf in the garage, whichever suits you best. **Price £11.50** + £2.50 post.

GPO HIGH GAIN AMP/SIGNAL TRACER. In case measuring only 5¼in x 3¼in x 1¼in is an extremely high gain (70dB) solid state amplifier designed for use as a signal tracer on GPO cables, etc. With a radio it functions very well as a signal tracer. By connecting a simple coil to the input socket a useful mains cable tracer can be made. Runs on standard 4½v battery and has input, output sockets and on-off volume control, mounted flush on the top. Many other uses include general purpose amp, cueing amp, etc. **An absolute bargain at only £1.85.** Suitable 80ohm earpiece **69p.**

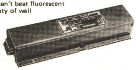
MINI MONO AMP on p.c.b., size 4"x 2"

approx. Fitted volume control and a hole for a tone control should you require it. The amplifier has three transistors and we estimate the output to be 3W rms. More technical data will be included with the amplifier. Brand new, perfect condition, offered at the very low price of **£1.15 each, or 10 for £10.00.**



12V FLUORESCENT LIGHTING

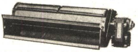
For camping – car repairing – emergeny lighting from a 12v battery you can't beat fluorescent lighting. It will offer plenty of well distributed light and is economical. We offer an inverter for 21" 13 watt miniature fluorescent tube. **£3.45.** (tube not supplied).



SUPER HI-FI SPEAKER CABINETS

Made for an expensive Hi-Fi outfit – will suit any decor. Resonance free cut-outs for 8" woofer and 4" tweeter. The front material is carved Dacron, which is thick and does not need to be stuck in and the completed unit is most pleasing. Colour black. Supplied in pairs, price **£6.90** per pair (this is probably less than the original cost of one cabinet) carriage £3.50 the pair.

TANGENTIAL BLOW HEATER

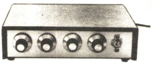


2.5 Kw quiet, efficient instant heating from 230/240 volt mains. Kit consists of blower as illustrated, 2.5 Kw element, control switch and data all for **£4.95.** post £1.50.

MOTORISED DISCO SWITCH

With 10 amp changeover switches. Multi-adjustable switches all rated at 10 amps, this would provide a magnificent display. For mains operated 8 switch model **£6.25,** 10 switch model **£6.75,** 12 switch model **£7.25.**

3 CHANNEL SOUND TO LIGHT KIT



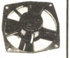
Complete kit of parts for a three-channel sound to light unit controlling over 2000 watts of lighting. Use this at home if you wish but it is plenty rugged enough for disco work. The unit is housed in an attractive two-tone metal case and has controls for each channel, and a master on/off. The audio input and output are by ¼" sockets and three panel mounting fuse holders provide thyristor protection. A four-pin plug and socket facilitate ease of connecting lamps. Special snip price is **£14.95** in kit form or **£19.95** assembled and tested.

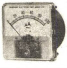
THIS MONTH'S SNIP

COMPUTER PRINTER FOR ONLY £4.95

Japanese made Epson 310 – has a self starting, brushless, transistorised d.c. motor to drive the print hammers, print drum – tape forward/reverse and paper feed.
Complete in module form with electronics including Printer Synchro Signal Amplifier & Printer Reset Signal Amplifier. Brand new and with technical and practical data. **£4.95** post £1.25.
Data separately for **£1.00.**

EXTRACTOR FANS – Mains Voltage
Ex-computer, made by Woods of Colchester, ideal as blower; central heating systems, fume extraction etc. Easy fixing through panel, very powerful 2,500 rpm but quiet running. Choice of 2 sizes, 5" **£5.50.** 6" **£6.50.** post £1 per fan.





100uA PANEL METER

Japanese made (Shinohara Electrical) so very good quality, these have a full vision front, are approx. 2" square and come complete with mounting studs and nuts. A thoroughly reliable instrument usually retailed at over £4, offered at a snip price this month of **£2.85** or 10 for **£25.00.**

12v MOTOR BY SMITHS

Made for use in cars, these are series wound and they become more powerful as load increases. Size 3½" long by 3" dia. These have a good length of ¼" spindle – price **£3.45.**
Ditto, but double ended **£4.25.**

EXTRA POWERFUL 12v MOTOR

Made to work battery lawnmower, this probably develops up to ¼ h.p., so it could be used to power a go-kart or to drive a compressor, etc. etc. **£6.90 + £1.50** post.

MINI-MULTI TESTER Deluxe pocket size precision moving coil instrument, Jewelled bearings - 2000 o.p.v. mirrored scale.

11 instant range measures:
DC volts 10, 50, 250, 1000.
AC volts 10, 50, 250, 1000.
DC amps 0 – 100 mA.

Continuity and resistance 0 - 1 meg ohms in two ranges. Complete with test prods and instruction book showing how to measure capacity and inductance as well. Unbelievable value at only **£6.75 + 50p** post and insurance.

FREE Amps range kit to enble you to read DC current from 0 - 10 amps, directly on the 0 - 10 scale. It's free if you purchase quickly, but of you already own a Mini-Tester and would like one, send **£2.50.**

FREE OUR CURRENT BARGAIN LIST WILL BE ENCLOSED WITH ALL ORDERS.

TRANSMITTER SURVEILLANCE
Tiny, easily hidden but which will enable conversation to be picked up with FM radio. Can be made in a matchbox – all electronic parts and circuit. **£2.30.** (Not licenceable in the U.K.).

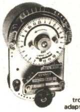
RADIO MIKE
Ideal for discos and garden parties, allows complete freedom of movement. Play through FM radio or tuner amp. **£6.90** comp. kit. (Not licenceable ih the U.K.).

FM RECEIVER

Made up and working, complete with scale and pointer needs only a speaker, ideal for use with our surveillance transmitter or radio mike. **£5.85.**

CB RADIO –

Listen in with our 40-channel monitor. Unique design ensures that you do not miss sender or caller. Complete kit with case, speaker and instructions only **£5.99.**

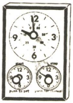


VENNER TIME SWITCH

Mains operated with 20 amp switch, one on and one off per 24 hrs. repeats daily automatically correcting for the lengthening or shortening day. An expensive time switch but you can have it for only **£2.95.** These are new but without case, but we can supply plastic cases (base and cover) **£1.75** or metal case with window **£2.95.** Also available is adaptor kit to convert this into a normal 24hr. time switch but with the added advantage of up to 12 on/offs per 24hrs. This makes an ideal controller for the immersion heater. Price of adaptor kit is **£2.30.**

STEREO HEADPHONES

Japanese made so very good quality. 8 ohm impedance. padded, terminating with standard ¼" jack-plug. **£2.99** Post 60p.



TIME SWITCH BARGAIN
Large clear mains frequency controlled clock, which will always show you the correct time + start and stop switches with the dials. Comes complete with knobs. **£2.50.**

SAFE BLOCK
Mains quick connector will save you valuable time. Features include quick spring connectors, heavy plastic case and auto on and off switch. Complete kit. **£1.95.**

6 WAVEBAND SHORTWAVE RADIO KIT
Bandspread covering 13.5 to 32 metres. Based on circuit which appeared in a recent issue of Radio Constructor. Complete kit includes case materials, six transistors, and diodes, condensers, resistors, inductors, switches, etc. Nothing else to buy if you have an amplifier to connect it to or a pair of high resistance headphones. **Price £11.95.**

SHORT WAVE CRYSTAL RADIO
All the parts to make up the beginner's model. Price **£2.30.** Crystal earpiece **65p.** High resistance headphones (gives best results) **£3.75.** Kit includes chassis and front but not case.

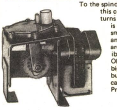
RADIO STETHOSCOPE
Easy to fault find – start at the arial and work towards the speaker – when signal stops you have found the fault. **Complete kit £4.95.**

INTERRUPTED BEAM
This kit enables you to make a switch that will trigger when a steady beam of infra-red or ordinary light is broken. Main components – relay, photo transistor, resistors and caps etc. Circuit diagram but no case. **Price £2.30**

MUGGER DETERRENT
A high-note bleeper, push latching switch, plastic case and battery connector. Will scare away any villain and bring help. **£2.50** complete kit.

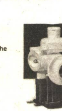
UNUSUAL MOTORISED PUMP

The motor is a normal ½" stack induction motor, mains operated. To the spindle is fitted a nylon worm drive, this considerably reduces speed and turns a nylon cog wheel to which is coupled a link operating a small bellows pump. The outlet and inlet to and from this pump are nylon pipes to which flexible tubing can be connected. Obviously, there will not be a big flow of air from this pump but quite considerable pressures can be developed.
Price **£4.60 + 50p.**



SOLENOID AIR VALVE

made to work with the above pump. This mains operated valve will stop the flow of air or gas when mains is applied to it. 220v - 230v model – **£3.45.** 100v model – **£2.30.**



J. BULL (Electrical) Ltd.

(Dept. EE), 34 - 36 AMERICA LANE,
HAYWARDS HEATH, SUSSEX RH16 3QU.

Established 30 YEARS

MAIL ORDER TERMS: Cash, P.O. or cheque with order. Orders under £10.00, add 60p service charge. Monthly account orders accepted from schools and public companies.
ACCESS & BARCLAYCARD orders phone Haywards Heath (0444) 54563.
CALLERS: to Haywards Heath or 2, Bentham Road, Off Elm Grove, Brighton.
BULK ORDERS: Please write for special quotation.

For your FREE Catalogue
Send 30p to cover P&P

Elliott Electronics Ltd.,
Leicester 0533–553293

F. Blakley & Sons Ltd.,
Heywood 0706–65087

F.P. Tools Ltd.,
Motherwell 069–65672

Horizon Electronics Ltd.,
Glastonbury 0458–33600

Ibis Electronics Ltd.,
Wokingham 0734–791171

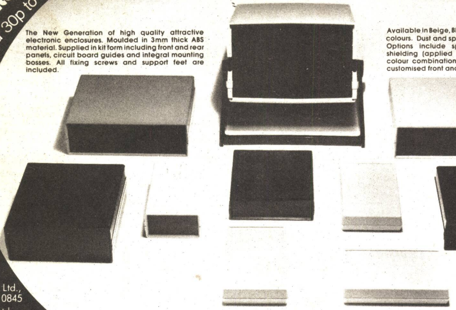
Batvale Marketing Ltd.,
Ely 0353–778320
Ely 0353–778756
(24 hours)

NEW DISTRIBUTORS WANTED

PACTEC

The New Generation of high quality attractive electronic enclosures. Moulded in 3mm thick ABS material. Supplied in kit form including front and rear panels, circuit board guides and integral mounting bosses. All fixing screws and support feet are included.

Available in Beige, Black, Blue, Grey plus combination colours. Dust and splash proof.
Options include special colours, RFI and EMI shielding (applied by a spray coating). Special colour combinations, UL approved materials and customised front and rear panels.



Neltronic Ltd.,
Dublin 510845

Cobbies Ltd.,
London. 01-699-2282

Microdigital Ltd.,
Liverpool. 051-227-2535

Electronica C G Ltd.,
Manchester. 061-788-0656

ELECTROWARE*

DUTTON LANE EASTLEIGH SO5 4AA TEL(0703)610944/5

AVAILABLE FROM ALL LEADING ELECTRONIC DISTRIBUTORS

Transam,
London. 01 405 5240

A. Marshall (London) Ltd.,
London. 01-624-0805

Interface Components Ltd.,
Amersham. 02403-22307

Spectron Electronics (Manchester) Ltd.,
Salford. 061-834-4583

Jee Distribution Ltd.,
Middlesex. 01-897-3429

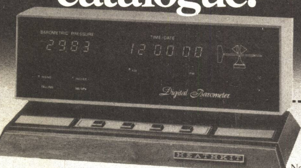
Watford Electronics Ltd.,
Watford. 0923-37774

Technomatic Ltd.,
London. 01-452-1500

New Bear Computing Store Ltd.,
Newbury. 0635-30505

* A DIVISION OF OK MACHINE & TOOL UK LIMITED

Kit yourself out with our new catalogue.



HEATHKIT
The world's biggest name in kit-form computers and electronics
AUTUMN 1981
Experience the pride, satisfaction and sense of accomplishment that comes with building Heathkit models—the world's most popular top performance electronics in kit form.

It's full of all sorts of exciting possibilities, including a digital barometer. So, if you don't trust the weather forecast, make your own. And get it right.

Like all Heathkits, it contains everything you need, right down to the right kind of solder. Unbeatable comprehensive assembly manual. Diagrams. Highest quality parts. Everything to make a first class professional job. One you'll be proud of. One that will give you far more satisfaction than a ready-made mass-produced shop-bought product can possibly offer.

Because you made it yourself.

To: Heath Electronics (UK) Limited, Dept (EE10),
Bristol Road, Gloucester GL2 6EE. Please send me a copy of your new catalogue. I enclose 28p in stamps.

Name____________________

Address ____________________

NB: If you are already on the Heathkit mailing list you will automatically receive a copy of the latest Heathkit catalogue without having to use this coupon.

You build on our experience

HEATHKIT

HEATH
ZENITH

BI-PAK BARGAINS

"IRRESISTABLE RESISTOR BARGAINS"

Pak No.	Qty.*	Description	Price
SX10	400	Mixed "All Type" Resistors	£1
SX11	400	Pre-formed ¼-½ watt Carbon Resistors	£1
SX12	200	⅛ watt Carbon Resistors	£1
SX13	200	¼ watt Carbon Resistors	£1
SX14	150	½ watt Resistors 22 ohm-2m2 Mixed	£1
SX15	100	1 and 2 watt Resistors 22 ohm-2m2 Mixed	£1

Paks SX12-15 contain a range of Carbon Film Resistors of assorted values from 22 ohms to 2.2 meg. Save pounds on these resistor paks and have a full range to cover your projects.

*Quantities approximate, count by weight.

"CAPABLE CAPACITOR PAKS"

Pak No.	Qty.*	Description	Price
SX16	250	Capacitors Mixed Types	£1
SX17	200	Ceramic Capacitors Miniature Mixed	£1
SX18	100	Mixed Ceramics 22pf-390pf	£1
SX19	100	Mixed Ceramics 470pf-.047uf	£1
SX20	100	Assorted Polyester/Polystyrene Capacitors	£1
SX21	60	Mixed C280 type capacitors metal foil	£1
SX22	100	Electrolytics, all sorts	£1
SX23	50	Quality Electrolytics 50-100mfd.	£1
SX24	20	Tantalum Beads, mixed	£1

*Quantities approximate, count by weight.

AUDIO PLUGS, SOCKETS AND ACCESSORIES

25 pieces of Audio Plugs, Sockets and Connectors to include DIN 180°-240°. Inline 3-6 Pin, Speakers, Phono, Jack, Stereo and Mono, etc. etc. Valued at well over £3 normal. Order No. SX25. Our Price £1.50 per pak. Guaranteed to save you money.

SX26	3 Prs. of 6 pin 240° DIN Plugs and Chassis Sockets.	50p
SX27	1 x Right Angle Stereo Jack Plug 6.3mm plus matching metal chassis mounting socket.	30p
SX28	4 Phono plugs and 2 dual phono connectors.	30p
SX29	1 x 2.5mm Plug to 3.5mm Socket adaptor.	20p
SX30	1 x 3.5mm Plug to 2.5mm Socket adaptor.	20p
SX31	1 x 3.5mm Plug to Phono Socket adaptor.	20p

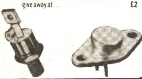
SX32	1 x Standard Jack Plug to Phono Socket adaptor.	25p
SX33	1 x Toggle Switch SPST Miniature. 125v 10A.	40p
SX34	1xToggle Switch SPDT Miniature. 125v 10A.	40p
SX35	1 x Rocker Switch SPDT Miniature. 240v 5A.	40p
SX36	1 x Right Angle Mono Jack Plug.	15p
SX37	20 pieces. 1, 2 & 4mm plugs and sockets (Banana). Matching colours and sizes.	£1
SX50	10 Assorted Switches. Toggle, Slide, Rocker, Push button.	£1

Guarantee

Satisfaction or your money back has always been BI-PAK's GUARANTEE and it still is. All these Sale items are in stock in quantity and we will despatch the same day as your order is received.

SX40	250 Silicon Diodes—Switching like IN4148 DO-35. All good—uncoded. Worth double our price. 45v 75mA.	£1.25
SX41	250 Silicon Diodes—General Purpose, like OA200/202. BAX13/16. Uncoded. 30-100v 200mA. DO-7.	£1.25

SX44	10 5A SCR's TO64. 3 x 50v. 3 x 100v. 2 x 200v. 2 x 400v. Super value less than ½ price.	£2
SX45	10 5A SCR's TO66. 2 x 50v. 2 x 100v. 4 x 200v. 2 x 400v. All coded. Brand new, a give away at...	£2



SEMICONDUCTORS FROM AROUND THE WORLD

100 A Collection of Transistors, Diodes, Rectifiers, Bridges, SCR's Triacs, IC's both Logic and Linear plus Opto's all of which are current everyday usable devices. **100**

Guaranteed Value over £10 at Normal Retail Price

yours for only **£4·00** Data etc. in every pak. Order No. SX56

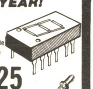
£1 FREE PAK

Get a £1 FREE PACK. Orders over £10 excluding VAT. Choose £1 Pack free (or 2 x 50p) add it to your order and save even more money. This offer only applies to this advertisement.

This offer only applies to this advertisement

BI-PAK'S OPTO BARGAIN OF THE YEAR!

Valued at over £10—Normal Retail—we offer you a pack of 25 Opto devices to include LED's Large and Small in Red, Green, Yellow and Clear. 7 Segment Displays both Common Cathode and Common Anode PLUS bubble type displays—like DL-33. Photo Transistors—similar to OCP71 Photo Detectors—like MEL11-12. This whole pack of 25 devices will cost you just



25 **£4·00** **25**

AND we guarantee your money back if you are not completely satisfied. FULL data etc included.

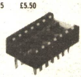
Order No. SX57.

IC SOCKETS
The lowest price ever.

The more you buy the cheaper they come!

Pin.	10 off	50 off	100 off
8	75p	£3.00	£5
14	80p	£3.25	£5.50
16	80p	£3.25	£5.50
16*	80p	£3.25	£5.50

Quilled *



BARGAINS

SX42	20 small .125 Red LED's	£1
SX43	10 Rectangular Green LED's .2	£1
SX46	30 Assorted Zener Diodes 250mw-2 watt mixed voltages, all coded. New.	£1
SX47	4 Black Instrument Knobs—winged with pointer ¼" Standard screw. Fit size 29 x 20mm.	50p
SX48	5 Chrome knobs, standard push fit. 15mm.	50p
SX49	20 Assorted Slider Knobs. Black/Chrome, etc.	£1

MORE BARGAINS!

SX51	60 metres PVC covered Hook-up wire single and stranded. Mixed colours.	£1
SX58	25 Assorted TTL Gates 7400 Series. 7401-7460.	£1
SX59	10 Assorted flip Flops and MSI TTL	£1
SX60	20 Assorted Slider Potentiometers	£1
SX61	25 Assorted Potentiometers, Rotary, Dual, etc.	£1
SX62	40 Assorted Pre-Sets Hor/Vert etc.	£1

STILL MORE!
SLIDER POTENTIOMETERS

Plastic 40mm Travel Mono

SX63	5 x 470 ohms Lin	SX67	5 x 47k Lin
SX64	5 x 1k Lin	SX68	5 x 47k Log
SX65	5 x 22k Lin	SX69	5 x 100k Lin
SX66	5 x 22k Log	SX70	5 x 1 meg Lin

All at 50p per pack.

SX71	50 BC108 "Fallouts". Manufacturers out of spec on volts or gain. You test.	£1
SX72	A mixed bundle of Copper clad Board, Fibre glass and paper. Single and double sided. A fantastic bargain.	£1

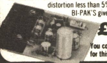
SX52	6 Black Heatsink will fit TO-3 and TO-220. Ready drilled. Half price value.	£1
SX53	1 Power finned Heatsink. This heatsink gives the greatest possible heat dissipation in the smallest space owing to its unique staggered fin design, pre drilled. TO-3 Size 45mm squarex 20mm high.	40p
SX54	TO-66 size. 35mm x 30mm x 12mm.	35p
SX55	1 Heat Efficiency Power Finned Heatsink. 90mm x 80mm x 35mm High. Drilled to take up to 4 x TO-3 devices	£1.50 each

5 watt (RMS) Audio Amp

High Quality audio amplifier Module. Ideal for use in record players, tape recorders, stereo amps and cassette players, etc. Full data and back-up diagrams with each module.

Specification:
● Power Output 5 watts RMS ● Load Impedance 8-16 ohms ● Frequency response 50Hz to 25 KHz—3db ● Sensitivity 70 mv for full output ● Input Impedance 50k ohms ● Size 85 x 64 x 30mm ● Total Harmonic distortion less than 5%

BI-PAK'S give away price



£2.25 each.

You could not Build one for this price.

BI-PAK's COMPLETELY NEW CATALOGUE

Completely re-designed. Full of the type of components you require, plus some very interesting ones you will soon be using and of course, the largest range of semiconductors for the Amateur and Professional you could hope to find.

There are no wasted pages of useless information so often included in Catalogues published nowadays. Just solid facts i.e. price, description and individual features of what we have available. But remember, Bi-Pak's policy has always been to sell quality components at competitive prices and **THAT WE STILL DO.**

BI-PAK'S COMPLETELY **NEW** CATALOGUE is now available to you. You will be amazed how much you can save when you shop for Electronic Components with a Bi-Pak Catalogue. Have one by you all the time—it pays to buy BI-PAK.

To receive your copy send **75p** plus 25p p&p.

SX38	100 Silicon NPN Transistors—all perfect. Coded mixed types with data and eqvt. sheet. No rejects. Real value.	£2.50
SX39	100 Silicon PNP Transistors—all perfect. Coded mixed types with data and eqvt. sheet. No rejects. Fantastic value.	£2.50

MULLARD. ASZ 17 PNP.
Germ TO-3 Power Trans.

60 VCB	8A.	Poss Replacement for
32 VCE	30W	AD130/131/140/149
20 VEB	Hfe 30min	OC25/26/28/35
		2N3613/14/
		17/2N1533

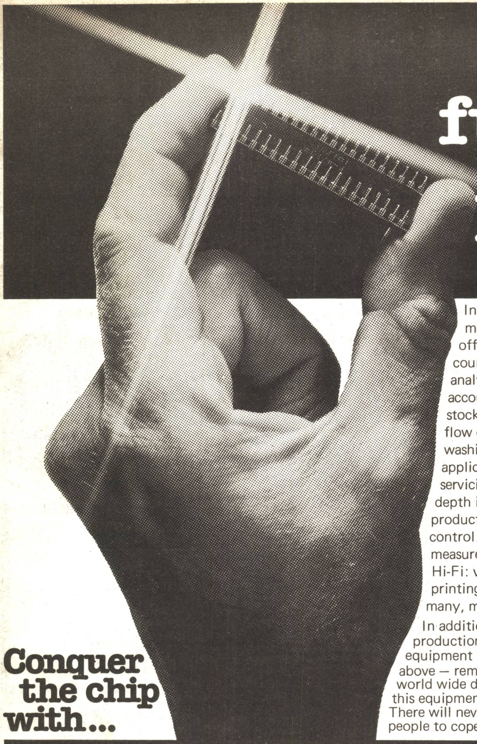
Great Value at **65p** each or 2 for **£1.**

BI-PAK

Send your orders to Dept EE10 BI-PAK PO BOX 6 WARE HERTS

Shop at 3 Baldock St Ware Herts
Terms, Cash with Order, same day despatch.
Access, Barclaycard also accepted. Tel (0920) 3182
Giro 388 7006. Add 15% VAT and 50p per Order
Postage and Packing

Use your credit card. Ring us on Ware 3182 NOW and get your order even faster. Goods normally sent 2nd Class Mail.
Remember you must add VAT at 15% to your order Total. Postage add 50p per Total order



The future is here

Industrial control systems motor vehicle production: office temperature control: counting: timing:metal analysis: food processing: accountancy: pay rolls: stock control: welding: flow control: alarms: washing machines: medical applications: motor car servicing: smoke detector: depth indicators: packaging. production management & control: stress & strain measurement: radio: T.V: Hi-Fi: video: typesetting: printing and publishing — and many, many others!

In addition to the design and production of electronics equipment now used in all the above — remember the enormous world wide demand for servicing this equipment.
There will never be enough trained people to cope!

Conquer the chip with...

British National Radio & Electronics School

SPECIALISTS IN ELECTRONICS TRAINING FOR OVER 40 YEARS

Training people for tomorrow!

POST NOW

FOR FREE BROCHURE

MASTER ELECTRONICS NOW!

The PRACTICAL way!

This new style course will enable anyone to have a real understanding of electronics by a modern, practical and visual method. No previous knowledge is required, no maths, and an absolute minimum of theory.

You learn the practical way in easy steps mastering all the essentials of your hobby or to start or further a career in electronics or as a self-employed servicing engineer.

All the training can be carried out in the comfort of your own home and at your own pace. A tutor is available to whom you can write personally at any time, for advice or help during your work. A Certificate is given at the end of every course.

You will do the following:

- Build a modern oscilloscope
- Recognise and handle current electronic components
- Read, draw and understand circuit diagrams
- Carry out 40 experiments on basic electronic circuits used in modern equipment
- Build and use digital electronic circuits and current solid state 'chips'
- Learn how to test and service every type of electronic device used in industry and commerce today. Servicing of radio, T.V., Hi-Fi and microprocessor/computer equipment.

New Job? New Career? New Hobby? Get into **Electronics** Now!

FREE!
COLOUR BROCHURE

Please send your brochure without any obligation to

NAME

ADDRESS

BLOCK CAPS PLEASE

I am interested in:

EE/10/81

☐ COURSE IN ELECTRONICS as described above
☐ RADIO AMATEUR LICENCE
☐ MICROPROCESSORS
☐ LOGIC COURSE

OTHER SUBJECTS

POST NOW TO:
British National Radio & Electronics School Reading, Berks. RG1 1BR.

A STAR IS BORN

THE AX-210 IS OUT OF THIS WORLD

THE WORLDS MOST VERSATILE WATCH

CASIO AX-210

Multiple Display LCD Analogue/Digital

ANALOGUE display of time plus:
- *Digital time display, 12 or 24 hour system.
- *Digital date, month and year, plus day flag.
- *Full month calendar display, current month.
- *Full month calendar display, next month. Auto-calendar pre-programmed to the year 2029.

Dual time modes
- *ANALOGUE display of local time plus digital second time zone, 12 or 24 hour system.

Alarm mode
- *ANALOGUE time with digital "Alarm Set Time", 24 hour system, AM/PM and "alarm on" indicators.
- *Buzzer for 20 seconds or select "Dixie Land", "Green Sleeves" or "My Darling Clementine".

Hourly time signal with 'Big Ben' type chimes at noon. Easily switched on or off.

RRP (34.95)
ONLY **£29.95**

Countdown alarm timer mode
- *Amazing ANALOGUE display, plus digital countdown. Normal and net times from 1 to 60 minutes with automatic retrieval of pre-entered time.

Stopwatch mode
- *ANALOGUE countup, with digital timing of net, lap and first and second place times from 1/100 second to 1 hour. Confirmation signal.

Easy setting of times and alarm with forward and backward stepping, and rapid run facility. Dims: 9.25 x 35 x 36mm approx. Mineral glass. Long life lithium battery. +/-15secs/month.

NEW LOWER PRICES

100 METRE WATER RESISTANT WATCHES

WITH C/D ALARM AND STOPWATCH

W150
£24.95*

W150C
£21.95*

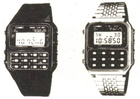
W100
£19.95

Time and auto calendar, alarm, hourly chimes, countdown alarm timer with repeat memory function, stopwatch. Time is always on display, regardless of mode. Stainless steel. (W100 Resin).

THESE SPACE INVADERS WILL ALARM YOU

CA90 (LEFT)
£19.95*

CA901 (RIGHT)
£29.95

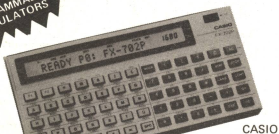


Time and auto calendar, calculator, alarm, hourly chimes, stopwatch, dual time. DIGITAL SPACE INVADER GAME.

CASIO's MOST AMAZING WATCHES EVER

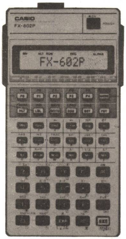
PROGRAMMABLE CALCULATORS

POWERFUL HIGH SPEED FX 702P COMPUTER USING BASIC LANGUAGE



CASIO
FX702P
(RRP £134.95)
ONLY **£119.95**

LCD scrolling display of alpha/numeric (dot matrix) characters. Input can be varied from 1680 programme steps, with 26 independent memories, to 80 programme steps with 226 memories. (All retained when switched off.) Up to 10 programmes can be stored (P0 to P9). Subroutine: Nested up to 10 levels. FOR-NEXT looping: Nested up to 8 levels. Straightforward programme debugging by tracing. Editing by moving cursor. 55 built-in scientific and statistical functions, including regression analysis and correlation coefficient, can be incorporated in programmes. Programme/data storage on cassette tape via optional FA 2 (available soon). Optional FP 10 mini printer, PLUG-IN ROM MODULES available soon. Two lithium batteries give approx. 200 hours continuous operation, with battery saving Auto Power Off after approx. 6 minutes non use. Dimensions: 17 × 165 × 82mm (5/8ths × 6½ × 3¼"). Weight: 180g (6·3oz).



CASIO FX602P
(RRP £84.95)
ONLY **£74.95**

- *LCD alpha/numeric (dot matrix) scrolling display (86 types).
- *Variable input capacity from 32 functional program steps with 88 independent memories, to 512 steps with 22 memories.
- *Memory and program retention when switched off.
- *Up to 10 pairs unconditional jumps (GOTO). Manual jump.
- *Conditional jumps and count jumps. Indirect addressing.
- *Up to 9 subroutines. Nesting possible up to 9 levels.
- *50 built-in scientific functions, all usable in programmes.
- *PAM (Perfect Algebraic Method) with 33 brackets at 11 levels.
- *Ultra high speed calculations.
- *Program storage on cassette tape using optional FA-1.
- *Compatible with FX-501/2P.
- *2 lithium batteries. Approx 660 hours continuous use.
- *Battery saving Auto Power Off
- *Only 9.6 x 71 x 141.2mm. 100g.

PRICE includes VAT and P&P. Send your company order, cheque, PO or phone your Access or Barclaycard number to

TEMPUS

LEADING CASIO DISTRIBUTOR

Dept EE10
164/167 East Road, Cambridge CB1 1DB
Telephone: 0223 312866

THE KEYBOARD REVOLUTION

CASIOTONE POLYPHONIC KEYBOARDS
With built in Amplifier and Loudspeaker.

CASIOTONE MT-30

(RRP £112.00)
ONLY £95.00

22 instruments over 3 octaves. 4-position sound memory. Battery or mains. O/P jack. Dims: 2½ x 22¾ x 6½". 6lb.

CASIOTONE 202

(RRP £325.00)
ONLY £275.00

"Son of success... The two harpischords demonstrate the Casiotone's talent for sparkling crystal clear tones... Even more impressive is the clav..." (Melody Maker).
49 instruments over 4 octaves. 4 voice memory function with push button selection. 3 vibrato settings and sustain. Pitch control. O/P jacks. AC only. 3½ x 34½ x 11½". 15.8lbs

CASIOTONE 301

(RRP £245.00)
ONLY £199.00

14 instruments over 4 octaves. 8 x 2 rhythm accompaniments. Vibrato and delayed vibrato. Start/stop, synchro start, tempo control tempo indicator, and rhythm volume. Pitch control. AC only. O/P jacks. 4½ x 31½ x 12½". 27lbs.

CASTIOTONE 401

(RRP 345.00)
ONLY £295.00

As 301 plus following: 16 rhythm accompaniments, with fill-in. Casio Auto Chord for one finger or auto accompaniment. Plays major, minor and 7th chords with bass. Balance control, C.A.C. lever, chord lever, memory lever and octave switch. Dimensions as 301. Weight 28.2lb.

BECOME AN INSTANT MUSICIAN NO EXPERIENCE NECESSARY

The success story of 1981. Hundreds sold already! As featured on "Tomorrow's World".

CASIO VL-TONE (VL-1)
Electronic Musical Instrument and calculator

(RRP 39.95)
ONLY £35.95

V1-1 records and plays back up to 100 notes as a melody. ONE KEY PLAY or AUTO PLAY of Piano, Violin, Flute, Guitar and Fantasy, or create your own unique sounds with A.D.S.R. 10 built-in AUTO RHYTHMS and TEMPO CONTROL. LCD digital readout of notes and tempo Also a calculator. Battery powered with memory and programme retention. Integral amplifier/speaker. Output jack. With song book. Dimensions: 1½ x 11½ x 3".

Send 20p for illustrated catalogue of selected casio and seiko products.

Buy British—Buy Douglas Transformers Mail Order from TITAN Transformers & Components
Central Hall Chambers, Duncombe Street, Grimsby, South Humberside DN32 7EG
Prices include 15% V.A.T. Send for our Catalogue.

DOUGLAS

12/24V RANGE PRI 220/240V
SEC: 0 12V 0V 12V

TYPE	AMPS		PRICE	P/P
	12v	24v	£	£
213	1	0·50	**2·65**	0·87
71	2	1	**2·77**	1·10
18	4	2	**3·98**	1·43
68	3	1·5	**3·46**	1·43
85	5	2·5	**6·06**	1·43
70	6	3	**6·67**	1·43
108	8	4	**8·03**	1·43
72	10	5	**8·66**	1·73
116	12	6	**9·31**	1·90
17	16	8	**11·46**	2·05
187	30	15	**19·23**	2·35
232	40	20	**27·61**	4·50

30/60V RANGE PRI 120/220/240V
SEC 0V 24V 30V 0V 10V 18V 30V
VOLTS 6 → 30 — 0 — 30

TYPE	AMPS		PRICE	P/P
	30v	60v	£	£
124	1	0·5	**3·30**	1·43
126	2	1	**6·36**	1·43
127	4	2	**7·86**	1·73
125	6	3	**11·78**	1·90
123	8	4	**14·72**	2·20
40	10	5	**17·10**	2·20
120	12	6	**19·44**	2·35
121	16	8	**27·70**	2·65
122	20	10	**32·05**	4·00
189	24	12	**37·02**	5·00

AUTOTRANSFORMERS 240/220 — 115V
65VA — 10 KVA
0V 115V 220V 240V

TYPE	VA	PRICE	P/P
		£	£
25	65	**3·90**	1·10
64	80	**4·82**	1·10
4	150	**6·21**	1·43
69	250	**7·54**	1·43
53	350	**9·73**	1·90
67	500	**11·70**	2·20
83	750	**13·51**	2·05
84	1000	**18·31**	2·35
95	2KVA	**34·36**	5·00
73	3	**64·74**	5·00
57	5	**97·85**	6·50
101	10	**179·05**	10·00

15-30V RANGE PRI 220/240V
SEC: 0V 12V 15V 0V 5V 9V 15V
VOLTS AVAILABLE 3 → 15 0 15

TYPE	AMPS		PRICE	P/P
	15v	30v	£	£
112	1	0·50	**2·84**	1·10
79	2	1	**3·29**	1·10
3	4	2	**6·18**	1·43
20	6	3	**7·19**	1·73
21	8	4	**8·52**	1·73
51	10	5	**10·57**	1·90
117	12	6	**11·94**	2·05
88	16	8	**16·14**	2·20
89	20	10	**18·54**	2·35
90	24	12	**20·57**	2·55
91	30	15	**23·63**	2·65
92	40	20	**33·21**	4·50

48/96V RANGE PRI 120/220/240V
SEC: 0V 36V 48V 0V 36V 48V
VOLTS 12 → 48 — 0 — 48

TYPE	AMPS		PRICE	P/P
	48v	96v	£	£
430	1	0·5	**4·69**	1·43
431	2	1	**7·84**	1·43
432	4	2	**12·94**	2·05
433	6	3	**14·62**	2·20
434	8	4	**20·04**	2·45
435	10	5	**28·75**	2·65
436	12	6	**36·16**	4·00
437	16	8	**39·47**	5·00

CASED AUTOTRANSFORMERS
240V LEAD IN 115V 2PIN SOCKET OUT

TYPE	VA	PRICE	P/P
		£	£
56W	20	**6·60**	0·87
64W	80	**8·43**	1·43
4W	150	**10·86**	1·73
69W	250	**13·17**	1·90
67W	500	**20·46**	2·20
84W	1000	**30·24**	2·55
95W	2000	**54·83**	5·00
73W	3000	**78·67**	6·50

25/50V RANGE PRI 120/220/240V
SEC: 0V 20V 25V 0V 8V 15V 25V
VOLTS OUT 5 → 25 — 0 — 25

TYPE	AMPS		PRICE	P/P
	24v	50v	£	£
102	1	0·50	**3·29**	1·43
103	2	1	**4·09**	1·43
104	4	2	**7·65**	1·73
105	6	3	**9·09**	1·90
106	8	4	**12·24**	1·90
107	12	6	**16·15**	2·20
118	16	8	**22·46**	2·55
119	20	10	**27·05**	2·55
109	24	12	**32·44**	4·50

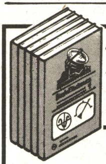
MAINS ISOLATORS (SAFETY SCREEN)
PRI 120-220-240V SEC 60V 55V 0V 55V 60V 60V 55V 0V 55V 60V

TYPE	VA	PRICE	P/P
		£	£
149F	60	**8·40**	1·73
150F	100	**9·71**	1·73
151F	200	**13·84**	2·05
152F	250	**16·69**	2·20
153F	350	**20·77**	2·55
154F	500	**26·03**	2·65
155F	750	**36·75**	5·00
156F	1000	**47·42**	6·00

LINE ADJUSTMENT AUTOTRANSFORMERS
0 200 210 220 230 240 250

TYPE	VA	PRICE	P/P
		£	£
415C	50	**2·31**	0·87
416C	100	**3·46**	0·87
417C	200	**4·00**	1·10
418F	350	**6·26**	1·43
419F	500	**6·74**	1·73
420E	750	**8·33**	1·90
421F	1000	**11·64**	2·05

Send Today 50p (Refundable with First Order) for Catalogue
TITAN TRANSFORMERS AND COMPONENTS
CENTRAL HALL CHAMBERS GRIMSBY DN32 7EG
MAIL ORDER ONLY - PRICES INCLUDE 15% VAT EE 8



ANNOUNCING A NEW SET OF BASIC ELECTRONICS

This 5 volume set contains over 500 pages.
Bound in stiff linen. Cover size 8½in x 5in.
Price £10.00 per set (we pay the postage).

- **Book 1.** Introducing Electronics
- **Book 2.** Resistors/Capacitors
- **Book 3.** Inductors/Diodes
- **Book 4.** Meters/Voltage-dividers
- **Book 5.** Transistor Project Circuitry

The manuals are unquestionaby the finest and most up-to-date available and represent exceptional value.
This series has been written in a fascinating, absorbing and exciting way, providing an approach to acquiring knowledge that is a very enjoyable experience. Suitable for industrial trainees, City and Guilds students, DIY enthusiasts and readers of electronic journals.
Each part explains electronics in an easy-to-follow way, and contains numerous diagrams and half tone blocks with construction details and circuit diagrams for making the following transistor projects: Lamp Flasher, Metronome, Wailer, Photographic/Monostable Timer, Metal Locator, Geiger Counter, Radio Receiver, Intercom., Intruder Alarm, Electronic Organ, Battery Eliminator, Anemometer, Sound Switch, Light and Water-operated Switches, Pressure-operated Switches, Light meter, Radio Thermometer, Ice Alarm,

Order now:
Selray Book Company
11, Aspen Copse,
Bromley,
Kent. BR1 2NZ.

OUR 100% GUARANTEE
Should you decide to return the set after 10 days examination, your money will be refunded by return of post.

Amount enclosed: £

Name:

Address:

EE10

MICRO TIMES

19 Mill St., Bideford, North Devon EX39 2JR, England
Telephone Bideford (023 72) 79798

It is our policy to offer you brand-new, full-spec. devices.
Prices subject to change without notice.
Schools, Universities: Official Orders welcome.

ORDERING INFORMATION
Please add 50p P. & P. Plus 15% V.A.T. to all orders.
EXPORT ORDERS ACCEPTED. Add 15% P. & P. on total order. V.A.T. not applicable.
Mark order EEO
ACCESS, BARCLAYCARD WELCOME

INTRODUCING CMOS AND TTL

CMOS

4001	12p
4002	12p
4006	68p
4007	13p
4008	60p
4010	36p
4011	12p
4012	18p
4013	33p
4014	60p
4015	62p
4016	28p
4017	53p
4018	58p
4019	36p
4020	65p
4023	18p
4024	38p
4025	14p
4026	£1·28
4027	35p
4028	62p
4029	70p
4030	48p
4031	£1·95
4040	66p
4042	55p
4044	60p
4046	74p
4047	78p
4048	44p
4049	27p
4050	27p
4051	60p
4052	60p
4056	£1·50
4060	86p
4063	£1·18
4066	36p
4068	18p
4069	15p
4070	22p
4071	18p
4075	20p
4077	22p
4078	20p
4081	18p
4093	42p
4503	65p
4510	66p
4511	51p
4518	70p
4520	70p
4560	£2·20
4572	30p

74LS TTL

74LS00	14p
74LS01	14p
74LS02	13p
74LS03	13p
74LS04	14p
74LS08	13p
74LS10	13p
74LS14	50p
74LS20	13p
74LS26	18p
74LS30	14p
74LS32	14p
74LS38	15p
74LS42	39p
74LS47	41p
74LS73	21p
74LS74	18p
74LS75	29p
74LS86	36p
74LS90	35p
74LS93	38p
74LS107	40p
74LS112	70p
74LS123	45p
74LS125	29p
74LS132	50p
74LS138	39p
74LS151	75p
74LS155	48p
74LS157	35p
74LS161	42p
74LS163	42p
74LS164	50p
74LS173	75p
74LS174	77p
74LS175	59p
74LS221	63p
74LS244	83p
74LS245	£1·20
74LS251	45p
74LS257	55p
74LS261	£3·10
74LS366	38p
74LS373	78p
74LS374	78p
74LS393	60p

LOW PROFILE DIL SOCKETS

40 pin	30p
28 pin	26p
24 pin	24p
22 pin	22p
18 pin	16p
16 pin	14p
14 pin	12p
8 pin	9p

LINEARICS

NE555	17p
NE556	48p
RC4136	65p
LM301AN	26p
LM311P	45p
LM318	£1·45
LM324N	42p
LM339N	40p
LM348N	75p
LM358P	38p
LM380	65p
LM3900N	46p
LM3914	£2·00
LM3915	£2·00
LM13600	£1·20
UA709	28p
UM741	15p
UA733	68p
UA747	58p
UA748	26p
TL074CN	£1·20
TL081CP	38p
TL082CP	60p
TL084CN	98p
LM3302	85p
TL690	£1·10
1488	70p
1489	70p
8T26	£1·50
8T28	£1·50
8T95	£1·50
ICM 7555	80p
LM1871	£1·90
LM1872	£1·90
SN76477N	£1·75 ea

SOUND EFFECTS GENERATOR

Suitable for video games, alarms, toys, etc.
Data £1·25. Large 51p S.A.E.

INTERSIL ICL 7660

Voltage Converter £2·25
Data 50p. Large S.A.E.

KITS FOR BEGINNERS

LIGHT ACTIVATED SWITCH
Used for automatic lighting control. £3·50

ELECTRONIC WHEEL OF FORTUNE
Fun kit. £5·00

ULTRONIC FLY REPELLER
A must for campers. £4·50

VOLTAGE REGULATORS 1A

7805 5V	53p
7812 12V	53p
7905 5V	58p
7912 12V	58p
100mA	
78L05 5V	29p
78L12 12V	29p
500mA	
79M12 12V	62p
79M05 5V	62p
723	32p

THYRISTORS

C106D	28p
TILs	
TIL32	45p
TIL209, red	10p
TIL232, green	18p
TIL212, yellow	16p
TIL216, red	18p
TIL228, red	20p
TIL220, red	12p
TIL224, yellow	18p
TIL311	£5·50
TIL312/3	£1·00
TIL321/A	£1·15
TIL330A	£1·15

VEROBLOC SOLDERLESS BREADBOARD

360 reliable contacts. Will accommodate any size IC. Can be fully interlocked with another. £3·55 each.

S100 Prototyping Boards:

Microboard Pattern 06-2175L	£16·40
Sq. Pad. Universal Pattern	£16·40
Prototyping Board for your APPLE/ITT 2020	£8·37

MEMORIES

	1+	25+
2144 450ns	£1·30	£1·25
2114 300ns	£1·45	£1·40
TC5514P	£3·65	£3·45
4K CMOS RAM (1K × 4) 450ns		
4116 200ns	£1·20	£1·18
4116 150ns	£1·70	£1·65
CMOS RAM 5101	£3·45	£3·40
HM 6116-3 (16K 150ns)	£15·50	£15·25

EPROMS

	1+	25+
2708 450ns	£2·55	£2·50
2716 5v. 450ns	£2·65	£2·60

2732 Intel. type £9·90 ea. Buy 5 off for £49.

FLOPPY DISC CONTROLLERS

FD1771	£19·50
FD1791-2	£32·00
WD1691D	£14·50
WD2143-01	£5·00

★ SPECIAL ★
Complete Packing £50
includes FD1791-2 + WD1691D + WD2143-01.
Set data available £3 (51p S.A.E. please).

Z80 COMBO CHIP

MK3886, 2½ meg. £19·50
Date £1 plus 51p S.A.E.

AY-3 8910 G SOUND COMPUTER CHIP

SPECIAL PRICE £6·95
Data £1. Large S.A.E. please.

ANTEX SOLDERING IRONS

Model CX, 17W.	£4·25
Kit SK1, 15W. incl. base/stand + solder.	£6·00
Kit SK3, 17W.	£6·00
Kit SK4, 25W.	£6·00
SK3 and SK4 complete with stand.	
MLX Repair Kit	£4·80
Can be used where no mains elec. is available.	
Spare Bits.	50p

6809 SINGLE BOARD COMPUTER ★ KIT ★

Complete kit £175 plus 15% V.A.T. £1 P. & P.
Uses Motorolas Powerful MC6809 CPU 4K/8K/16K ROM, 2K RAM, ACIA, PIA, 8080 simulated I/O, RS-232 Handshake. 8 Sel. Baud Rates. Manual includes: 11 × 17in. Schematic Parts list. User Notes, Software listings and more!

Bare Board	£48★★
Uses 6809, 6850, 6821—buy set for	£18·50
ADMONS (2716)	£24·00

Data available. S.A.E. please.

SUPPORT DEVICES

6520	£3·15	Z80CTC	£4·25
6522	£5·00	Z80PIO	£4·25
6532	£7·60	Z80ACTC	£5·40
6810	£2·50	Z80APIO	£5·40
6821	£1·90	Z80DMA	£14·95
6845	£15·00	Z80ADMA	£18·00
6850	£1·95	Z80S10/0	£17·50
6852	£3·30	Z80AS10/0	£22·50
8212	£1·75	Z80S10/1	£17·50
8216	£1·75	Z80AS10/1	£22·50
8228	£3·95	Z80S10/2	£17·50
8255	£4·00	Z80AS10/2	£22·50

CPU's

6502	£5·45	8080A	£4·15
6504	£7·25	8085A	£6·45
6802	£5·70	Z80	£4·00
6809	£15·00	Z80A	£5·85

NEW S-100 PROMBLASTER

PROGRAMS MOST FAMILIES OF EPROMS!

- ★ Accepts 1K/2K/4K or 8K Eproms.
- ★ Extended Device Option.
- ★ Phantom Slave Option.
- ★ All Programming characteristics. Software controlled!
- ★ Accepts single or 3 supply parts.
- ★ Device Address switch selectable.
- ★ On-Board Wait States.

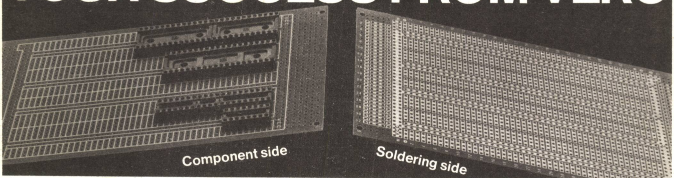
Put your frequently used routines into EPROM!

BAREBOARD	£49·00
PROMWRITER	£40·00
KIT	£175·00

Incl. all parts, sockets and Promwriter
Del. 2 weeks.

S-100 KLUGE CARD NEW

TWO SIDES TO YOUR SUCCESS FROM VERO



The Low Cost Eurocard Size Microboard

Fully Compatible with indirect connectors and Card Frames to the latest international specifications.

Accepts any Integrated circuit package – allows high packing density.

Screen Printed with 'island' pattern for ease of use – ideal for solder and wire wrap applications.

Vero Electronics Limited, Retail Dept., Industrial Estate,
Chandler's Ford, Hampshire SO5 3ZR. Tel (04215) 62829

PLEASE SUPPLY QTY.	ORDERCODE	DESCRIPTION	SIZE	PRICE	
	200-22271B	MICROBOARD	160 x 100mm	£3.47 each	(including VAT & carriage)
	200-22270E	MICROBOARD	160 x 233mm	£5.47 each	

Name: ____________________

Address: ____________________

____________________ Postal Code: ____________________

My Access/Barclay No. is: ____________________ Signed ____________________

Vero has countless reasons to celebrate 20 years of Veroboard.

That's how Vero began and many of you started.

Twenty years ago Vero introduced Veroboard to the designer and hobbyist market.

It was then unique in its concept and is still one of the basic boards for the electronics industry. Such is the influence that Veroboard has had, and is still having, that the very name has become part of general vocabulary. Twenty years is a long time in a new industry and Vero have been in the forefront with their standards, quality control and customer service throughout that time.

From Veroboard through Card Frames to Vero Cases, we are proud to be of service and hope that you will agree that sales of millions of Veroboards is a suitable cause to celebrate our twentieth birthday.

Please Telephone for further information about Veroboard and our other products.

Phone: Chandler's Ford

(04215) 62829

vero

Vero Electronics Ltd., Retail Department,
Industrial Estate, Chandler's Ford, Hampshire. SO5 3ZR.

EDITOR
F. E. BENNETT

ASSISTANT EDITOR
B. W. TERRELL B.Sc.

PRODUCTION EDITOR
D. G. BARRINGTON

ART EDITOR
R. F. PALMER

ASSISTANT ART EDITOR
P. A. LOATES

TECHNICAL ILLUSTRATOR
D. J. GOODING

EDITORIAL OFFICES
Kings Reach Tower
Stamford Street,
London SE1 9LS
Phone: 01-261 6873

ADVERTISEMENT MANAGER
R. SMITH
Phone: 01-261 6671

REPRESENTATIVE
R. WILLETT
Phone: 01-261 6865

CLASSIFIED MANAGER
C. R. BROWN
Phone: 01-261 5762

MAKE-UP AND COPY DEPARTMENT
Phone 01-261 6615

ADVERTISEMENT OFFICES
Kings Reach Tower
Stamford Street,
London SE1 9LS

Projects... Theory... and Popular Features...

COME AND JOIN US

Whether you intend to make a career of it or indulge in it for amusement, and maybe profit, in your leisure, electronics is a very worthwhile subject to study. We have enthusiasts from ten through to four-score, at least, amongst our regular readers. So if you are not already a committed follower of electronics, be assured you won't be too young nor too old to make a start.

Our new series *Teach-In 82* offers an easy way to understand the principles of electronic circuits and to gain practical experience with actual components through simple experiments in our 12-part course.

A SURE FOUNDATION

By happy chance this issue which includes a free piece of Veroboard ("stripboard") coincides with the 20th anniversary of its invention. Like many clever inventions, this one happened almost accidentally.

Veroboard was the brain child of a couple of electronic engineers who were designing machine tool control equipment in the factory of Vero Precision Engineering Ltd. Their success in making a few one-off "wiring boards" from copper clad plastics laminate was noted by someone on the management who had the foresight to realise its potential. So this "printed wiring board" was put into large scale production (a "natural" for the firm's milling capabilities) and marketed. The electronics industry took to the product as ideal for assembling circuits incorporating the new semiconductor devices, and constructors soon afterwards discovered its virtues and gave a further fillip to sales. Because of its success a separate company Vero Electronics was soon set up.

Those of us who had wrestled with transistors in the 'fifties, using makeshift methods and materials such as Paxolin, hardboard cut-offs and even cardboard as mounting bases for components, or tag strips designed for the valve era, seized on this new product with delight. It is no exaggeration to say today's thriving pastime of electronics has been built literally on Veroboard.

We congratulate the original inventors and the company managers whose bold step turned out to be no gamble.

TEN POPULAR DESIGNS

With newcomers to electronics particularly in mind, we include this month a fine selection of *Ten Popular Designs*, any one of which can be accommodated comfortably on the free piece of Veroboard. As anniversaries are in the air, we chose one design from each complete year of EVERYDAY ELECTRONICS. That makes us just ten, come next month.

FRED BENNETT

Our November issue will be published on Friday, October 16. See page 683 for details.

Readers' Enquiries

We cannot undertake to answer readers' letters requesting modifications, designs or information on commercial equipment or subjects not published by us. All letters requiring a personal reply should be accompanied by a stamped self-addressed envelope.

We cannot undertake to engage in discussions on the telephone.

Component Supplies

Readers should note that we do not supply electronic components for building the projects featured in EVERYDAY ELECTRONICS, but these requirements can be met by our advertisers.

All reasonable precautions are taken to ensure that the advice and data given to readers are reliable. We cannot however guarantee it, and we cannot accept legal responsibility for it. Prices quoted are those current as we go to press.

Everyday ELECTRONICS

VOL. 10 NO. 10 OCTOBER 1981

CONSTRUCTIONAL PROJECTS

SUSTAIN UNIT *For electric guitar by R. A. Penfold* 654

EE MINILAB *Breadboarding unit with built in electronics by O. N. Bishop* 664

TEN POPULAR DESIGNS 671

Snap Indicator..................*672*
Tape Noise Limiter............*674*
Continuity Tester *676*
Fuzz Box *678*
Soil Moisture Unit *680*
Damp Locator *673*
Heads and Tails Game *675*
Photo Flash Slave *677*
Opto Alarm *679*
Ice Alarm *681*

CAPACITANCE METER *A desirable test instrument by J. R. W. Barnes* 690

GENERAL FEATURES

EDITORIAL *Come and Join Us; A Sure Foundation; Ten Popular Designs* 652

TEACH-IN '82 *Part 1: Conduction in Materials and Devices by O. N. Bishop* 658

COUNTER INTELLIGENCE *A retailer comments by Paul Young* 663

SHOP TALK *Product news and component buying by Dave Barrington* 670

EVERYDAY NEWS *What's happening in the world of electronics* 684

FOR YOUR ENTERTAINMENT *Pacemaker, Talking Memories, Chatter Box by Barry Fox* 685

RADIO WORLD *Armchair Travellers, Television News by Pat Hawker G3VA* 686

INTRODUCTION TO LOGIC *Part 6: AND, OR, NAND, Symbols and Truth Tables by J. Crowther* 688

JACK PLUG AND FAMILY *Cartoon by Doug Baker* 694

SQUARE ONE *Beginners Page: Fixed value resistors* 697

READERS' LETTERS *Your news views* 698

BRIGHT IDEAS *Readers' hints and tips* 698

Back Issues

Certain back issues* of EVERYDAY ELECTRONICS are available worldwide price 80p inclusive of postage and packing per copy. Enquiries with remittance should be sent to Post Sales Department, IPC Magazines Ltd., Lavington House, 25 Lavington Street, London SE1 0PF. In the event of non-availability remittances will be returned.

*** *Not available:* October 1978 to May 1979.**

Binders

Binders to hold one volume (12 issues) are available from the above address for £4·40 (home and overseas) inclusive of postage and packing. Please state which Volume.

Subscriptions

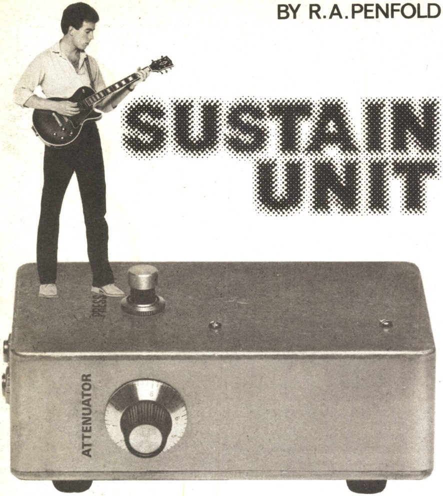
Annual subscription for delivery direct to any address in the UK: £11·00. Overseas: £12·00. Cheques should be made payable to IPC Magazines Ltd., and sent to Room 2613, Kings Reach Tower, Stamford Street, London SE1 9LS.

© IPC Magazines Limited 1981. Copyright in all drawings, photographs and articles published in EVERYDAY ELECTRONICS is fully protected, and reproductions or imitations in whole or in part are expressly forbidden.

SEE PAGE 671

BY R.A.PENFOLD

SUSTAIN UNIT



SUSTAIN units are primarily intended for use with electric guitars, and as the name implies, devices of this type extend the maximum duration of the note from the instrument.

The output signal from a guitar normally has a high initial ampltude which quickly drops to a much lower level, and then steadily dies away to virtually nothing over a few seconds. A sustain unit boosts the signal as it dies away, giving an almost constant output amplitude and effectively increasing the maximum time for which a note can be sustained.

METHODS OF OPERATION

There are two reasonably simple ways of obtaining a sustain effect, the most simple one being to use a clipping circuit of the type outlined in the block diagram of Fig. 1(a). Here the input signal is first considerably amplified and then fed to a clipping circuit. The latter normally uses a couple of silicon diodes to clip the signal at about ±0·6V.

Thus the output amplitude is set at this level by the clipping action and is largely independent of the input level. In fact, however large the input level may be, the output will not rise above the clipping level.

It can fall *below* the clipping level if the input signal is inadequate, but the input amplifier is given a high enough gain to ensure that this does not happen until a few seconds after the commencement of a note.

DRAWBACKS

One major drawback to this system is that by clipping the signal it is considerably distorted. Strong harmonics of the fundamental note are produced, giving the same effect as a "Fuzz" unit. A low pass filter is therefore normally included at the output of the circuit in order to attenuate the harmonics that would otherwise give an undesired effect.

This does not completely solve the problem though, since strong intermodulation distortion is caused by the clipping, and this produces a very unpleasant sounding output if more than one note at a time is played. Most of the intermodulation distortion products will not be attenuated by the low filter as they are mainly in the same frequency range as the desired signals.

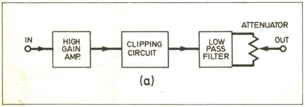
SECOND METHOD

The second method, which is shown in the block diagram of Fig. 1(b), is slightly more complicated but is capable of much improved results. As before, the signal is first fed to an amplifier. It is then fed to a voltage controlled attenuator (v.c.a.), which is a circuit that reduces the amplitude of the input signal by an amount which depends upon the voltage fed to its control terminal.

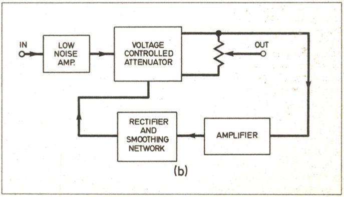
In this type of circuit the v.c.a. gives little attenuation with only a small control voltage, and increasing attenuation as the control voltage is raised.

The control voltage is derived from the output of the v.c.a. by way of a rectifier and smoothing network, and a certain amount of additional amplification is also needed in order to obtain a sufficiently large control voltage.

Fig. 1 (below). Simple methods for obtaining sustain effect. (a) clipping circuit; (b) voltage controlled attenuator or compressor type of circuit.



(a)


IN
LOW NOISE AMP.
VOLTAGE CONTROLLED ATTENUATOR
OUT
RECTIFIER AND SMOOTHING NETWORK
AMPLIFIER

(b)

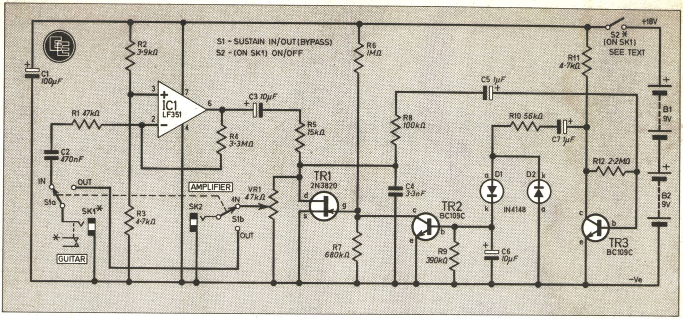


Fig. 2. The complete circuit diagram of the Sustain Unit.

Under quiescent condition or with only a very low input level there will be at most only a very small control voltage, and a greatly amplified signal appears at the output. At higher input levels a significant control voltage is produced, and the signal receives a lower level of amplification in consequence.

At still higher input signal amplitudes the control voltage is increased further, and little or no amplification is provided by the unit. This has the effect of holding the output signal at a certain level, provided the input is sufficiently strong to produce this output level. Raising the input above this minimum level causes the gain of the circuit to drop and results in very little increase in the output level.

This gives the required sustain effect because as the input level decays, the gain of the circuit increases so as to maintain the output level.

ATTACK AND DECAY TIMES

The attack and decay times of the smoothing circuit must be carefully chosen so that the unit will respond with suitable rapidity to changes in input amplitude, but not so rapidly that the waveform of the processed signal is altered and significant distortion is generated.

The unit will not properly respond to the transient at the beginning of each note as it is too brief, but this does not matter and is really of benefit as it maintains the guitars natural attack, which is lost when the clipping method is employed.

With either system a variable attenuator is included at the output so that the signal level from the unit can be adjusted to one which is comparable to the output from a guitar.

THE CIRCUIT

Fig. 2 shows the complete circuit diagram for the unit finally evolved, and this is of the second type, which is usually called a "compressor".

The input amplifier is based on operational amplifier IC1. R2 and R3 bias the non-inverting input to slightly more than half the supply voltage, and R4 biases the inverting input and output of the device to the same potential due to a negative feedback action. This bias voltage gives the circuit optimum unclipped peak to peak output voltage swing capability.

The voltage gain of the amplifier is determined by the ratio of R1 to R4, and is approximately equal to R4 divided by R1, or about 70 in other words. This gives sufficient sensitivity to produce a good sustain effect with any normal instrument.

It is essential for the input amplifier to have a low noise level as the circuit will produce maximum output from input levels below 1mV. A poor noise performance would result in low input levels being swamped in noise. IC1 provides a suitably high performance in this respect as it is a bifet type which has a low noise jfet input stage. The distortion performance is also very good, and these devices are ideal for critical audio applications.

VOLTAGE CONTROLLED ATTENUATOR

The v.c.a. is based on *p*-channel jfet TR1, and it is its drain to source resistance plus R5 that form the two elements of the attenuator. C3 couples the output from IC1 to the attenuator.

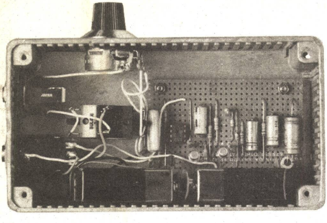
Under quiescent conditions R6 and R7 strongly reverse bias TR1 so that it is fully switched off and exhibits a drain to source resistance of typically about 1,000 megohms. It therefore causes no significant losses through R5, although output attenuator VR1 and other loads on the output do cause losses of a few dB. However, the circuit still exhibits a voltage gain of more than 50.

Some of the output signal is coupled by C5 to a common emitter amplifier which uses TR3 in a conventional configuration. The gain of the amplifier is far higher than is necessary, and so R8 is inserted in the signal path to reduce the gain to a more appropriate level. This resistor also boosts the input impedance of the stage and thus helps to reduce loading on the output.

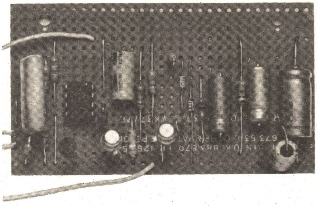
The output from TR3 is fed by C7 and R10 to the smoothing and rectifier circuitry which is comprised of D1, D2, C6 and R9.

If the input signal is sufficiently strong, the positive bias produced by the rectifier and smoothing circuit will be high enough to switch on TR2 to some extent. TR2 then reduces the bias on TR1, causing it to conduct more heavily and increasing the losses through R5. The stronger the input signal is made, the lower the bias voltage fed to TR1 and the greater the losses through R5. This gives the required stabilisation of the output signal amplitude.

C4 rolls-off the high frequency response of the circuit (above about 4 to 5kHz) under quiescent or low signal level conditions. This helps to give an improved signal-to-noise ratio



Layout of components within the case.



Completed circuit board removed from case.

under the conditions where any noise will be most noticeable.

C4 has little effect at medium and high input levels where the resistance of TR1 is quite low, and the shunting effect of C4 even at the highest audio frequencies is of far less significance.

BYPASS SWITCH

S1 can be used to bypass the circuit so that the sustain effect can be switched out when it is not required. S1 is a heavy duty push button type switch having a sequential action, so that it can be operated by foot.

S2 is the on/off switch, and on the prototype it is actually a make-contact on the input socket (SK1) so that the unit is automatically switched on when the guitar is plugged into it. This is quite common practice with effects units.

An 18 volt supply is needed in order to enable the unit to handle high input signal levels without clipping occuring, and this is provided by two small 9 volt batteries (PP3 size) connected in series. The unit only consumes about 5mA.

PERFORMANCE

The graph of Fig. 3 shows input voltage versus output voltage for the prototype. As can be seen from this, the compression commences at less than 1mV, and increasing the input to as much as 50mV or so causes only a marginal increase (about 15 per cent) in the output. At higher input levels TR1 saturates and the gain of the unit stays at approximately unity.

As the output from a guitar is only likely to reach a high enough level to saturate TR1 during the initial transient (if at all), when full compression is not necessary or achieved anyway, in practice the unit gives the desired effect with the initial attack followed by an almost constant output until the input signal decays to an insufficient level.

CONSTRUCTION starts here

HOUSING THE UNIT

Due to the high sensitivity of the unit it is advisable to use a metal case so that the circuitry is screened from sources of electrical interference. The case must also be very strong due to the manner in which the unit will be used. A diecast aluminium box measuring about 152 x 82 x 50mm makes an ideal housing for the project.

S1 is mounted on the top panel of the case, and this panel should be left clear of other controls, or sockets, which could otherwise cause confusion or get in the way when operating S1. Apart from this the physical layout of the unit is not critical.

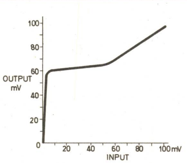


Fig. 3. Input voltage versus output voltage characteristic of the Sustain Unit.

CIRCUIT BOARD

The circuit is built on a piece of 0·1in matrix stripboard, size 31 holes by 17 strips. The component layout and the breaks needed in the copper strips on the underside of the panel are shown in Fig. 4. The two mounting holes are 3·3mm in diameter and accept either 6BA or M3 mounting bolts.

Before mounting the completed panel connect flying leads of sufficient lengths at the four appropriate points. Spacers must, of course, be used over the mounting bolts to hold the connections on the underside of the panel clear of the metal casing.

There is a small amount of point to point fashion wiring, and this is illustrated in Fig. 5. SK1 has d.p.d.t. contacts, but four tags are unused in this application as only a s.p.s.t. switch is required. One of the four spare tags is used as a convenient point to provide the interconnection between the two battery clips.

USING THE UNIT

Best results from the unit will probably be obtained with the volume control on the guitar set at maximum. VR1 is merely adjusted to give the same volume level with the unit switched in as when it is bypassed.

The unit provides a considerable increase in gain, and this could lead to problems with stray mechanical or magnetic feedback between the loudspeaker and pick-up if the latter is not a humbucking type. In such cases it is essential to ensure that the guitar is as far away from the loudspeaker as can be arranged, and if necessary the volume control on the guitar can be backed off slightly.

SUSTAIN UNIT

COMPONENTS

Resistors

R1	47k
R2	3·9k
R3	4·7k
R4	3·3M
R5	15k
R6	1M
R7	680k
R8	100k
R9	390k
R10	56k
R11	4·7k
R12	2·2M

All miniature ¼ watt ±5% (±10% over 1M)

Potentiometer

VR1	47kΩ log. carbon

Capacitors

C1	100μF 25V elect.
C2	470nF type C280
C3	10μF 25V elect.
C4	3·3nF ceramic plate
C5	1μF 25V elect.
C6	10μF 25V elect.
C7	1μF 25V elect.

Semiconductors

IC1	LF351 f.e.t. input op-amp
TR1	2N3820 *n*-channel f.e.t.
TR2	BC109C silicon *npn*
TR3	BC109C silicon *npn*
D1	1N4148 small signal silicon diode
D2	1N4148 small signal silicon diode

Switches

S1	d.p.d.t. sequential heavy duty push button type
S2	Part of SK1

Sockets

SK1	Standard (6·3mm) jack socket with d.p.d.t. contacts
SK2	Standard (6·3mm) jack socket

Miscellaneous

Diecast aluminium box measuring about 152 × 82 × 50mm. 0·1in matrix stripboard. Control knob. Two PP3 size batteries and connectors to suit. Wire, solder.

See **Shop Talk** page 670

COMPONENTS approximate cost £8·50

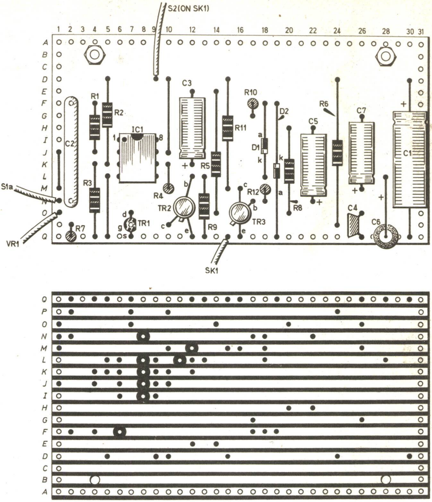


Fig. 4. Circuit board details, topside and underside.

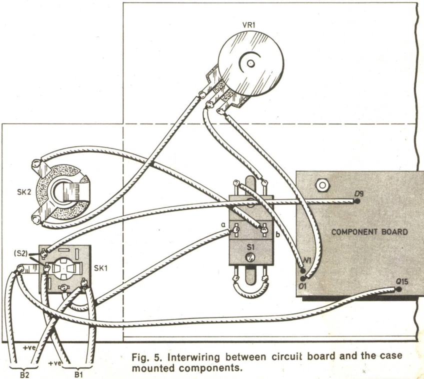


Fig. 5. Interwiring between circuit board and the case mounted components.

EE TEACH-IN 82

PART 1

BY O.N. BISHOP

A new 12-part series

BASIC ELECTRONIC THEORY WITH EXPERIMENTS

CONDUCTION IN MATERIALS AND DEVICES

ELECTRONICS is the study of devices in which electric charge is moved. The movement of charge is called conduction, so it makes sense to begin our course in electronics by studying this. We will then be ready to look next month at some of the devices in which charge is conducted.

ELECTRIC CHARGE

First of all we should ask "What is electric charge?" The surprising answer to this is that we do not really know what it is, in spite of the fact that it is a major factor in all our lives today.

We know that electrons and protons carry electric charge and that these charges are of two different kinds. We call them negative and positive, but the use of the word "negative" does not mean that electrons are lacking in charge when we say they carry negative charge.

Negative charge is just as real as positive charge. The two kinds of charge are simply opposites in the sense that one unit of positive charge (as carried by a proton) exactly cancels out one unit of negative charge (as carried by an electron). We will leave out of this discussion the fractions of unit charge carried by quarks and similar sub-atomic particles.

The only way we can tell that a particle is charged is when we can detect a force caused by the charge. The force between two similarly charged particles drives them apart. The force between two oppositely charged particles attracts them together.

The amount of charge on an electron is exceedingly small. For practical use we need a unit of charge much larger than this. Our unit is the **coulomb** (symbol C) which equals the charge on about six million million million electrons.

COMPONENTS required for experiments during the first 6-Parts of Teach-In 82. Complete kits of these (LIST 2) may be obtained from the retailers listed on page 670.

COMPONENTS approximate cost £10

Resistors

Quantity	*Value*
1	5·6Ω
1	39Ω
3	100Ω
2	180Ω
1	330Ω
2	470Ω
1	560Ω
1	1kΩ
1	1·5kΩ
2	4·7kΩ
2	10kΩ
1	22kΩ
1	100kΩ
1	150kΩ
1	220kΩ
1	270kΩ
1	470kΩ
1	1MΩ

All ¼W or ⅓W carbon types ± 5% tolerance. Types prepared for p.c.b.s. with short preformed leads are not suitable.
All leads on components to be between 0·5 and 0·8mm diameter to fit specified breadboard (Verobloc).

Capacitors

Quantity	*Value*	
1	470pF—ceramic plate or disc	
1	47nF—metallised polyester, Mullard C280, ITT PMT2R or similar.	
2	10µF electrolytic	16V types preferred, axial or radial leads. Short lead-out types are not suitable.
1	47µF electrolytic	
2	220µF electrolytic	

All to be suitable for working at 12V. Very large types should not be obtained.

Semiconductors

Quantity	*Type*
1	VA1067S thermistor 150 kilohn @ 25°C
1	TIL100 infra-red photodiode
1	1N4148 small signal silicon diode
2	VN10KM VMOS power field-effect transistor
1	ORP12 light dependent resistor
2	ZTX300 silicon *npn* transistor
1	555 timer i.c. (8 pin d.i.l.)
1	CD4011 CMOS quad 2-input NAND gates
1	CD4027 CMOS dual J-K flip-flop
1	CD4070 CMOS quad 2-input exclusive-OR gates

Miscellaneous

Quantity	*Description*
1	**Verostrip:** 0·1 inch matrix 75 strips size 213 × 38mm (Vero 200-21086K)
1	**Crystal Microphone Insert**
1	**Toggle Switch:** standard size s.p.s.t.
1	**Rotary Switch** 1-pole, 6-way, break before make contacts
1	**Knob:** to fit rotary switch and match those in Minilab kit
20	**Terminal Pins** single-sided to fit Verostrip (Vero half-pin 200-21017B)
5m	**P.V.C. Covered Wire:** stranded 7/0·2mm: 1 metre of each of 5 different colours
1m	**Tinned Copper Wire:** 20 s.w.g.
	Hardware:
2	4BA bolt (25mm)
2	4BA shakeproof washer
6	4BA nut

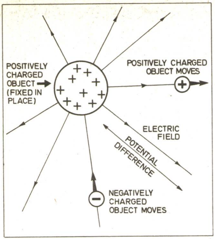

POSITIVELY CHARGED OBJECT (FIXED IN PLACE)
POSITIVELY CHARGED OBJECT MOVES
ELECTRIC FIELD
POTENTIAL DIFFERENCE
NEGATIVELY CHARGED OBJECT MOVES

Fig. 1.1. Electric field around a charged object. Potential is high close to the object, but low at a distance.

CONDUCTION

If charge is to be carried from one place to another, there are three requirements:

(1) Charge carriers
(2) A medium in or through which the carriers can move
(3) An electric field to provide the force to make them move.

Electrons have already been mentioned as examples of charge carriers. These are the type we find most often in electronics, but there are other kinds, as we shall see later.

An electric field exists when there is a **potential difference** between one point and another. In Fig. 1.1 the charged object contains many particles which are positively charged. There is an electrical field around the object. Positively charged bodies are repelled by it, negatively charged objects are attracted by it.

If these charged objects are free to move, they will move. There will be movement of electric charge—which is what electronics is all about.

When we talk about the movement of charge we do not usually think of the amount of charge being moved. We think of the rate at which charge is moved. Our unit for rate of movement of charge is the **ampere,** (symbol A). A current of one ampere carries charge from one place to another at the rate of 1 coulomb per second.

The motion of charge causes a magnetic field, and an ammeter uses this effect to measure current.

The strength of an electric field is measured by the potential difference (p.d.) between two points in the field. Roughly speaking, the p.d. tells us how much energy is needed to move a charged object from one point in the field to the other. The unit for measuring p.d. is the **volt** (symbol, V).

Now that we have looked at some ideas on conduction, let us see how well different kinds of material can conduct by carrying out some simple experiments.

It is expected that the Minilab (see page 664) will take a little time to complete, but this should not prevent you from carrying out the experiments immediately. The only facilities we shall be using from the Minilab in the early experiments will be the battery supply, the meter and of course the Verobloc.

You can see from the experiment layouts, in Fig. 1.3 for example, that connections to the meter and battery are made via screw terminal blocks. Essentially this is all that is required, especially for the simple experiments. Even the terminal blocks may be dispensed with initially with the meter and battery leads "plugged" directly into the Verobloc.

The experimental layouts therefore are suitable for use with and without Minilab.

EXPERIMENT 1.1

How well do different materials conduct?

Look at the circuit diagram (Fig. 1.2) and how to set it out on the breadboard in Fig. 1.3. You are using the electric field produced by a 3V battery. In other words, the p.d. between the ends of wires *A* and *B* is 3V. The meter is included in the circuit to measure the current. A sensitive meter is used because the currents will be small.

When the needle is deflected fully to the right the current is 100μA. The symbol "μA" is read as "microampere", or "microamp" for short. A microampere is one millionth of an ampere.

The aim of this experiment is to measure the current that flows through different materials when a p.d. of 3V is applied. Use the two bare ends of wires *X* and *Y* as probes to touch against the different materials and devices listed below. Measure the current (if any), and keep a note of its value. Be ready to take the probes away quickly if the needle should swing beyond the right-hand end of the scale. Here are some tests to try:

(a) Hold one bare wire end *X* and *Y* in Fig. 1.3 in each hand, gripping its metal firmly. Measure the current *flowing through your body* (seen on the meter). Remember this point in future, and always hold the wire by its insulation. Remember this also when handling plugs—always hold

EXPERIMENT 1.1

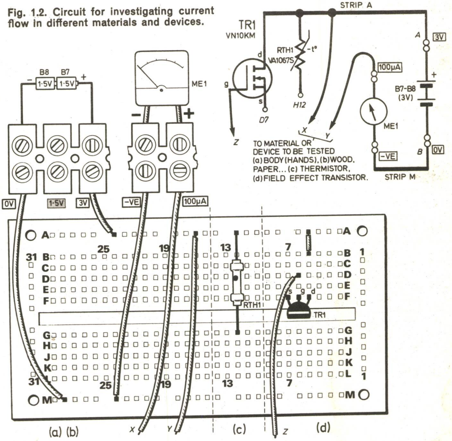


Fig. 1.2. Circuit for investigating current flow in different materials and devices.

Fig. 1.3. A suggested layout on the breadboard and wiring to meter and batteries for the circuit in Fig. 1.2.

them by their plastic casing.

(b) Test a piece of wood, a piece of glass, pieces of plastic, paper, a piece of thin paper tissue about 5cm × 1cm soaked in water, a film of carbon (make this by holding a piece of glass over a burning candle to "smoke" it) by holding wires *X* and *Y* on the various materials as seen in Fig. 1.3b.

(c) To test the thermistor RTH1. The layout for this is shown in Fig. 1.3c. Place wire *X* in breadboard location *H12*. Watch what happens to the current as you hold the thermistor tightly in your hand to warm it. Next put the thermistor on a block of ice to cool it.

(d) the VMOS transistor can next be tested, see Fig. 1.3d for layout. Transfer lead *X* to breadboard location *D7*.

Think of the transistor as containing a bar of semiconductor material joining the source (*s*) and drain (*d*) terminals. Measure the current that flows between these two terminals. Try warming the transistor by touching a piece of hot metal (not red-hot!) against the metal tag for a few seconds only. What effect does this have on the current? Try cooling it by touching a block of ice against the tag. Try touching the lead end *Z* connected to the gate (*g*) terminal with your finger. We will look again at that effect next month.

In the remaining two sections of Experiment 1.1, the items pass rather large currents. If you put a resistor in the circuit, R4 in Fig. 1.4, most of the current can be made to pass through the resistor with only 1 per cent passing through the meter. This means that a reading of 100μA is now equivalent to a total current of 10000μA, or 10 milliamps (10mA; a milliamp is one ten thousandth of an ampere).

The value of the resistance to achieve this is calculated by dividing the meter internal resistance value by 99. In the case of the meter used in the prototype Minilab, its internal resistance was 4000 ohms. Dividing by 99 gives 44 ohms. The nearest value to this from the range of resistor values generally available (**preferred values**) is 39 ohms which explains why this value appears in Fig. 1.4.

For meters other than this one, the value may be found printed on the facia. If not it may be approximately determined by subtracting the sum of the values of R2 and R3 supplied with your Minilab Kit from 25000 ohms. Use the nearest preferred value below this.

The circuit for sections (e) and (f) of Experiment 1.1 is shown in Fig. 1.4 with the layout on the breadboard in Fig. 1.5. The wire ends marked *X* and *Y* should be touched on:

(e) The contacts of a 25W or 40W electric light bulb; the current flows through its metal filament which is very thin.

(f) Some water in a glass (distilled water if you have some); then add a little table salt and stir.

EXPERIMENT 1.1

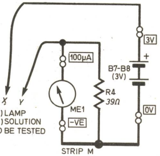


Fig. 1.4. Circuit for investigating current flow. Resistor R4 allows currents greater than meter maximum to be measured.

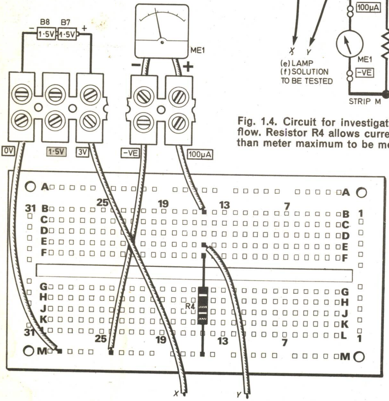


Fig. 1.5. A suggested layout for the circuit in Fig. 1.4.

GOOD AND BAD CONDUCTORS

Experiment 1.1 has shown that some substances (for example, wood, plastic, dry paper) are bad conductors. They have high resistance. Some pass no current at all. The reason is that they have no **mobile charge carriers** in them.

It is true that we can charge materials of this kind by rubbing them with a dry cloth for example. This leaves electrons scattered over their surface (or removes electrons leaving a positive charge) but electrons are attached to atoms and are not free to move, so there is no current.

Some other materials such as metals, are good conductors. The filament of a lamp can carry a large current, even though it is so thin.

Electrons can easily escape from the atoms of a metal. They wander in the space between the atoms. These "free" electrons are available as charge carriers whenever the metal is in an electric field.

Water is a poor conductor. But when salt is dissolved in it, the solution is a good conductor. Such a solution is called an **electrolyte.**

Carbon is a poor conductor but useful in electronics. We use it to make resistors.

Two of the devices you tested showed interesting behaviour. The thermistor is a rod of semiconducting material. When cold it is a very poor conductor, but it begins to conduct slightly more when warmed. This is because electrons escape from the atoms of the semicoducting material as its temperature rises. These electrons then act as charge carriers. We shall have more to say about conduction in semiconductors later.

The VMOS transistor (TRI) also contains a bar of semiconducting material which behaves in the same way as the thermistor when it is warmed or cooled. A more interesting point is that the current passing along the bar changes when you touch your finger against the gate terminal. We shall investigate this effect in more detail next month.

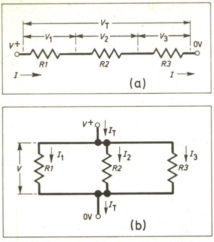


Fig. 1.6. Two ways of connecting resistors. In (a) they are said to be in series and in (b) they are connected in parallel.

OHM'S LAW

In the early 19th century a German physicist, George Ohm, did some experiments rather like the ones you have just done. He did not have semiconductors to work with, but he measured the current flowing through wires of various kinds. He summarised his results like this:

> "The current passing through a wire at constant temperature is proportional to the p.d. between its ends."

This has since become known as **Ohm's Law.** Nowadays we use this idea to define our unit for measuring resistance that a wire or other piece of material offers to the flow of electric current. We say that if the p.d. between two ends of a wire (or other material) is 1V and the current is 1A the resistance of the wire is 1 ohm (symbol, Ω).

We can write this as a formula which we shall use many times during this course:

$$V = IR$$

In this formula, V is the p.d., measured in volts; I is the current, measured in amperes; and R is the resistance, measured in ohms. We can write the formula in two other ways:

$$I = \frac{V}{R} \quad \text{and} \quad R = \frac{V}{I}$$

Given any two of the quantities, we can calculate the third.

COMBINING RESISTANCES

There are two ways in which resistances can be combined, in **series** and in **parallel.** Fig. 1.6 shows what these terms mean.

In Fig 1.6a the same current I passes through each resistance. So we can write:

$V_1 = IR1$ and $V_2 = IR2$ and $V_3 = IR3$

The total p.d. across all three resistances is:

$$V_T = V_1 + V_2 + V_3 = I(R1 + R2 + R3)$$

If the combined resistance of all three is R_T, then:

$$R_T = \frac{V_T}{I} = \frac{I(R1 + R2 + R3)}{I}$$
$$= R1 + R2 + R3$$

In short, their combined resistance equals the sum of their separate resistances.

With resistances in parallel, there is the same p.d. across all three resistances, but different currents may flow through each. The total current is:

$$I_T = \frac{V}{R1} + \frac{V}{R2} + \frac{V}{R3}$$
$$= V\left(\frac{1}{R1} + \frac{1}{R2} + \frac{1}{R3}\right)$$

Their total resistance can be found from the formula:

$$\frac{1}{R_T} = \frac{I_T}{V} = \frac{1}{R1} + \frac{1}{R2} + \frac{1}{R3}$$

MEASURING P.D.

Given a known current and a known resistance we can calculate the p.d. across the resistance. We make use of this fact in electronics to measure p.d. by measuring current.

The meter in Minilab has resistors R1, R2 and R3 connected in series with it, see Fig. 1 on page 665. The resistance of the meter in the prototype is 4000Ω (4 kilohm, or 4kΩ), and the resistance of R1 is 100kΩ. Their combined resistance in series is 104kΩ, according to the formula above. If we connect a supply voltage, say V_1 to −VE and 10V to pass a current of 100μA through the meter and R1, the p.d. between the sockets is $V_1 = IR = 1000 \times 10^{-6} \times 104 \times 10^3 =$ 10·4V.

The factor 10^{-6} is used because current is in microamps ($1\mu A = 10^{-6}A$), and the factor 10^3 is used because the resistance is in kilohms ($1k\Omega = 10^3\Omega$).

EXPERIMENT 1.2

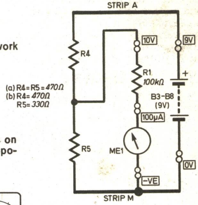


Fig. 1.8. A simple potential divider network composed of two resistors.

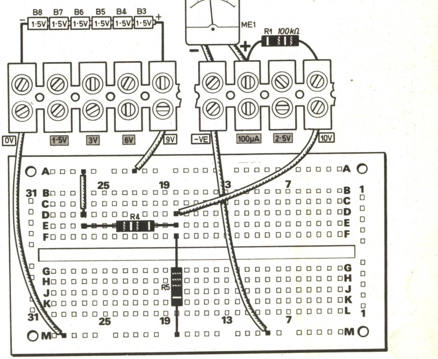


Fig. 1.9. The layout of the components on the breadboard to investigate the potential divider circuit of Fig. 1.8.

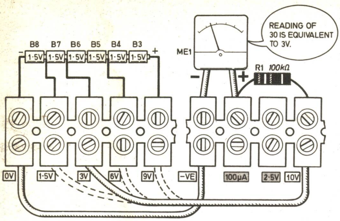

READING OF 30 IS EQUIVALENT TO 3V.
ME1
B8 B7 B6 B5 B4 B3
1·5V 1·5V 1·5V 1·5V 1·5V 1·5V
−
+
R1 100kΩ
0V
1·5V
3V
6V
9V
−VE
100µA
2·5V
10V

Fig. 1.7. Testing the meter connected as a 10 volt full scale voltmeter. The wire shown in 3V position should be placed in each of the positions: shown dotted.

The meter shows full scale deflection (f.s.d.) when the p.d. is 10·4V, which is close enough to 10V for our purposes.

The series resistor converts the microammeter to a voltmeter reading 10V f.s.d. Readings of other p.d.s are in proportion: when the needle points to "40", the p.d. is 4V.

To test the voltmeter, connect up as in Fig. 1.7 and put the meter 10V lead in to each of the battery terminal block positions in turn *except* 12V.

When we connect to −VE and 2·5V the meter is in series with R2 and R3. Their total resistance is 4kΩ+20kΩ+1kΩ=25kΩ. For a f.d.s. current of 100µA, the p.d. between sockets is

$$V=100\times10^{-6}\times25\times10^{3}=2\cdot5\text{V}.$$

This gives a 2·5V f.s.d. voltmeter, useful for measuring lower p.d.s. with greater accuracy.

EXPERIMENT 1.2

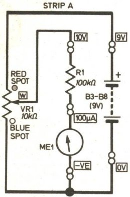


Fig. 1.10. Using a potentiometer instead of the two fixed value resistors in Fig. 1.8.

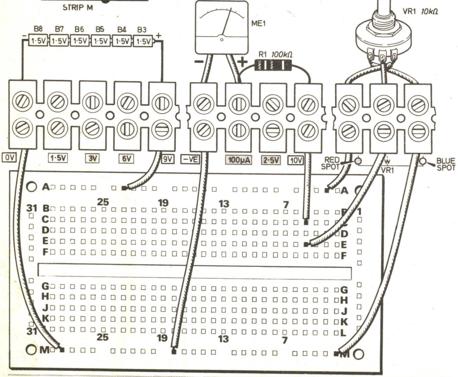


Fig. 1.11. Suggested layout of components for the circuit in Fig. 1.10.

POTENTIAL DIVIDER

If we require a p.d. which is less than any of the fixed p.d.s from the battery, we can use two resistors in series as shown in Fig. 1.8. If the p.d. across the two resistors is V_{IN}, the current is $I=V_{IN}/(R4+R5)$. The p.d. across the lower resistor is V_{OUT} and $I=V_{OUT}/R5$. Since I is the same for both equations:

$$\frac{V_{IN}}{R4+R5}=\frac{V_{OUT}}{R4}$$

giving:

$$V_{OUT}=\frac{V_{IN}\,R5}{R4+R5}$$

The network of resistors has divided the potential, so we call it a **potential divider.** The calculations assume that no current flows from the divider into the meter or into any other circuit that may be connected at the same point. In practice a small current does flow to the meter, so the actual p.d. across *R5* is always a little less than the calculated value.

However, provided the outflowing current is small, we need not worry about this. In general, if the current leaving the junction of the resistors is less than one tenth of the current flowing through the network, we ignore its effects.

EXPERIMENT 1.2

To make and investigate a potential divider network

The circuit for this experiment is shown in Fig. 1.8 and the suggested layout on the breadboard in Fig. 1.9. The voltage across R5 can be read from the meter.

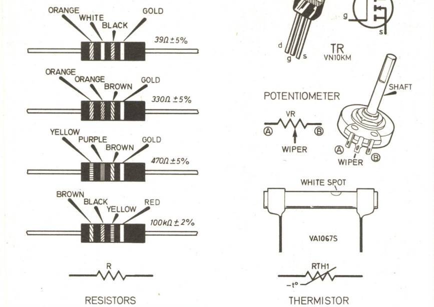
Measure the output p.d., using the meter. Does this agree with the result obtained by calculation? Try again with a 330Ω resistor in place of R4. Then make R4=470Ω and R5=330Ω and try again.

If we connect a variable resistor as in the circuit of Fig. 1.10, it acts like two resistors in series, with the wiper at their junction. The resistor becomes a potential divider which can be set to give *any* p.d. between 0V and V_{IN}. Investigate its action, using the layout shown in Fig. 1.11.

PRACTICE SPOT

In Experiment 1.1 you measured current through various materials and devices when the p.d. was 3V. Calculate the resistance of (a) your body, hand to hand; (b) the wet tissue; (c) the lamp; (d) the thermistor warm and cold; (e) the transistor warm and cold.

TEACH-IN 82 COMPONENTS IDENTIFIED



The components used in this month's experiments are shown above. Here we show a physical drawing of the component, its circuit symbol and its circuit reference.

There are four different resistor values required. The value of each is coded on the body in the form of a number of coloured rings. See page 697 for full account of resistor coding.

The transistor is a special type, a VMOS power field effect transistor. This must be connected exactly as shown in circuit diagram—otherwise the device may suffer damage.

The potentiometer can be considered as a resistor which can be tapped anywhere between its extremes. As the shaft is rotated clockwise, the wiper moves towards *B*.

The VA1067S rod thermistor is a heat sensitive resistor made of semiconductor material. May be connected in circuit either way round.

To be continued

QUESTION TIME

1.1. Which part of an atom carries negative charge?
1.2. What kind of force exists between two positively charged objects?
1.3. What is the practical unit of electrical charge?
1.4. Name three examples of charge carrier.
1.5. If a current of 2 amperes flows for 3 seconds, how much charge is carried?
1.6. Which kinds of material make the best conductors?
1.7. What does f.s.d. stand for?
1.8. The bands on a resistor are brown, red, orange. What is its resistance?
1.9. When a resistor has a p.d. of 3.4V across it, the current flowing through it is 5mA. What colours are the bands on the resistor?
1.10. If the potential divider of Fig. 1.8. has $R1=150k\Omega$ and $R2=15\Omega$ and $V_{IN}=11V$, what is V_{OUT}?

Answers in Part 2.

COUNTER INTELLIGENCE

By PAUL YOUNG

Ordering Components

Around this time of the year many new recruits are commencing the most fascinating of all hobbies, "Electronics", and it is my agreeable task to guide their faltering footsteps in the mysteries of purchasing components. This being the case I must ask my regular reader to bear with me, that is, unless he or she wishes to refresh his or her memory on these procedures.

You may be extremely lucky and have a little man round the corner who will attend to some of your requirements, but many of you will have to rely on Mail Order. Don't be dismayed by this, there are plenty of us dying to fulfil your needs and while I and my colleagues have always been eager to help you, the recession has put a keener edge on our performance. In other words it is a "Buyers Market".

I suggest your first move is to send for about four or five catalogues and then study them carefully. Make a list, showing who has the best selection of capacitors, resistors, etc., and so on. For example, dealer "A" might have the best selection of variable capacitors, and dealer "B" the largest selection of transistors, this will be a useful guide when ordering parts for a project. Let me say, at this point, never fail to read the *Shop Talk* page which gives invaluable information especially on the sources of supply of unusual components.

Let us assume you have reached the point where you have made your list of what you wish to buy. Most mail order companies supply order forms, always use them when provided. Paperwork is time consuming and costly and not many of us keep copies of your orders. Instead we ask you to return the original, in case of a query, so make sure you keep the order until you have checked that all the goods are there and as ordered.

Naturally, you are keen to start on your project and any delays are irritating but always remember your letter may take two or three days to reach us and even with a by return service you must allow another two days and most likely there will be an intervening weekend.

Many firms have a fixed postal charge which means you lose on the small parcels and gain on the big ones. Last, but most important of all, write your name and address clearly on your order.

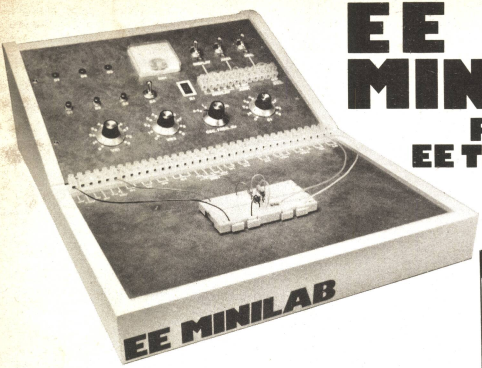
Component Ratings

Probably the two most used building blocks in construction are resistors and capacitors, so a few words on these would not be out of place. The two factors you need to know with capacitors are the capacity given in either Picofarads (pF), Nanofarads (nF) or Microfarads (μF) and the voltage.

The designer usually states quite clearly the type he expects to be used, that is, ceramic, silver mica, polyester or electrolytic, but remember that with electrolytics the tolerance is usually +50 per cent and −20 per cent. As far as voltage goes, it is usually safe to go above the suggested one, but not below, remembering of course that as the voltage increases, so does the physical size!

The two factors given with resistors are wattage and tolerance but here we have a curious anomaly. It might be thought that the wattage is given to indicate the current passing through them, which in term means it must dissipate a certain number of watts, but when the value given is below one watt it is usually given as an indication of physical size; larger ratings and in some cases even smaller wattage types may be used.

As regards tolerance, these days most resistors are 5 per cent which is adequate for the majority of purposes.



EE MINILAB

For use with EE TEACH-IN 82 series

BY O.N.BISHOP

The Minilab was designed to provide a portable electronic experimental deck for those who are starting to follow the *Teach-In 82* series beginning this month, see page 658. With the facilities provided by Minilab and the additional components listed on page 658, you will be able to undertake every experiment described in Parts 1 to 6 of this series.

When the series is over, Minilab will continue to be of great use to you. In fact it is a generally handy workplace for any electronics enthusiast, ranging from the beginner to one who has reached the stage of wanting to design and build his or her own circuits.

PLEASE PRESENT THIS COUPON
TO YOUR LOCAL RETAILER

£1 OFF

the purchase of one verobloc©
manufactured by

VERO ELECTRONICS LIMITED

TO THE PURCHASER
This coupon is worth £1 when you purchase your verobloc©

TO THE RETAILER
Please accept this coupon against the purchase of one verobloc©. Please send it to VERO ELECTRONICS LTD as part payment of your monthly account.

OFFER VALID, IN THE UK ONLY UNTIL
THE 30th NOVEMBER 1981

Everyday Electronics October 1981

FEATURES

The general purpose circuitry within the basic Minilab is shown in Fig. 1 and provides the facilities listed below. All facilities are accessible through terminal strips TB1, TB2, TB3, mounted immediately behind the Work Panel.

Power Supply

With the younger and least experienced experimenters in mind we have decided that a battery is the safest and most convenient form of supply. The circuits to be built have low current requirements, for which a battery is perfectly adequate. There is also the great advantage that the Minilab is completely portable and can be used in any room, without need for a mains power socket.

The battery supply consists of eight dry cells, B1 to B8 providing a maximum voltage of 12 volts(V) d.c. It is tapped at several points to give 1·5V, 3V, 6V, 9V, as well as a balanced ±6V supply for operational amplifiers.

The batteries are housed in the case of Minilab, together with all the other facilities.

COMPONENTS

A complete kit of the components listed below may be ordered as LIST 1 from the retailers appearing on page 670.

Resistors

R1	100kΩ
R2	20kΩ } see text
R3	1kΩ } see text

All ¼W carbon or metal film ±2%

Potentiometers

VR1	10kΩ carbon lin. law
VR2	100kΩ carbon lin. law

Capacitor

C1	500pF miniature variable capacitor, solid dielectric

Semiconductors

D1, 2, 3	TIL209, TIL220 or similar red light emitting diodes with fixing clip/bush (3 off)

Switches

S1, S2	push-to-make, release-to break miniature (2off)
S3	push-to-break, release-to-make miniature
S4	single-pole double-throw standard toggle

Miscellaneous

ME1	100μA d.c. moving coil panel meter—see text
LS1	8ohm moving coil loudspeaker, 45 to 80mm dia.
B1-B8	HP2 1·5 volt cells (8 off)
TB1-TB3	2-amp 12-way screw terminal blocks (3 off)

Verobloc solderless breadboard or similar—see text; battery holders to suit four HP2 type cells (2 off); control knobs, skirted with index line to fit VR1, VR2 and C1 (3 off); p.v.c. covered stranded wire, 7/0·2mm, 1 metre each of six different colours (6 metres); OBA solder tags (3 off)—only for in-line battery holders; 2A 12-way terminal block (for modules); materials for case, see CUTTING LIST on page 667.

Guidance only Approx cost £15 excl. batteries and case

Meter

A single low-cost microammeter ME1 is provided for measuring currents up to 100 microamps. The series resistors (R1, R2 and R3) allow it to be used to measure voltages up to 2·5V or 10V.

The values of the resistors, in particular R2 and R3, shown in the circuit diagram have been selected for use with a particular meter having an internal resistance of 4 kilohms. Teach-In 82 kit suppliers will be selecting resistor values to suit the meter supplied which may be other than 4 kilohm. This selection is only likely to affect the values of R2 and R3. It is possible that only a single resistor will be required and supplied.

By means of suitable shunt resistors it can also be used for measuring currents larger than 100 microamps. The way to use this meter will be fully explained during the series.

Light emitting diodes

Small lamps have many uses as visual indicators as will be explained during the series. The Minilab is equipped with three visual indicators in the form of light emitting diodes (l.e.d.s) D1, D2 and D3 mounted on the Control Panel. These are semiconductor devices which when excited by the application of a voltage, emit a red light.

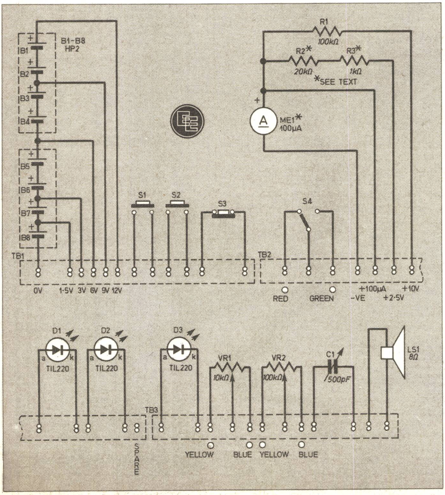
Switches

There are four switches S1, S2, S3 and S4 having three different functions: S1 and S2 are push-to make, release to break button types; S3 is the inverse of the previous being push-to-break, release-to-make push button type; S4 is known as a single pole double-throw (s.p.d.t.) or single-pole two-way. Here the centre terminal makes with either of the other two depending on its position.

Potentiometers

There are two potentiometers VR1, VR2 having values of 10 kilohm and 100 kilohm respectively. These devices have three terminals. The extremes have a specially prepared carbon track between them forming a resistance in these instances of 10 kilohm and 100 kilohm. The centre terminal, known as the wiper is in contact with the track and its position along the track is determined by the angular position of its shaft. Variable resistors may be formed by using the wiper and one other terminal.

Fig. 1. Circuit diagram of the basic Minilab.



Variable Capacitor

A variable capacitor C1 having a capacitance suitable for radio tuning circuits is included.

The capacitance is a function of the fixed distance between, and overlap area of, two sets of parallel plates. Angular rotation of its shaft moves one set of plates relative to the other varying the overlap and thus its capacitance.

Loudspeaker

A miniature low power loudspeaker is fitted to the base of the Minilab for audio experiments. This transducer converts electrical signals to sound waves.

Modules

The Minilab described in this issue is the basic version. It will be noted that there are vacant spaces on the Control Panel. These are left ready to receive the controls and readout of three special modules, that are to be built into Minilab at a later date during the series. The circuits and the way the modules work will be described in the series as it progresses.

Each module is simple to construct and is a useful experimental and design tool. The three modules to be included are:

(a) a low-noise signal amplifier

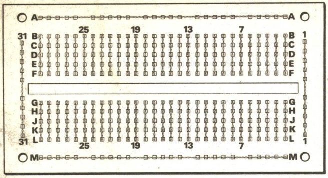
(b) a square-wave oscillator which can be set to any one of four frequencies

(c) a 7-segment l.e.d. display.

BREADBOARD

A "solderless breadboard" is used for interwiring the components according to the circuit diagram. It has a matrix of "sockets" arranged on a 0·1 inch grid and these are grouped (wired internally) to provide blocks of common sockets, in all 58 five-input sockets with four separate bus bars on the perimeter in the case of the Verobloc used here. The centre section sockets each allow up to five components to be interconnected at one point and should therefore be suitable for many circuits. This number can be extended by linking two or more groups as required.

The leads of the components and wires are simply pushed into the sockets to make a good electrical connection. This is an economical and quick way of wiring up components for experiments and project testing. When the experiment is completed, they can be quickly "unplugged" ready for re-use in other experiments.



How the contacts are interwired inside the Verobloc.

The Verobloc may be used as a "handle" to remove the Work Panel allowing access to the storage compartments.

The breadboard is fitted to the Work Panel with double-sided adhesive tape. There is ample working space around the breadboard with plenty of room for mounting an additional board or boards should your enthusiasm take you in the direction of expansion.

The breadboard used in Teach-In 82 is the Verobloc, which is one of the smaller and least expensive of the 0·1 inch matrix boards. Should you already possess a different board of this type (for example EuroBreadBoard or Protoboard) it can be used instead of the Verobloc.

Note that integrated circuits are to be used on several occasions during the series, so it is essential that whatever breadboard you install is capable of holding at least two 16-pin dual-in-line integrated circuits.

CONSTRUCTION starts here

CASE

Details for constructing the Minilab case are shown in Fig. 2. Also contained on this page is the cutting list for all parts. All dimensions are in millimetres.

All parts should be cut to size according to this list and any rough edges arising from saw cuts rubbed smooth with glasspaper. Nails and woodworking adhesive, Resin W, were used for all fixings. The nails were later punched below the surface and filled in with Polyfilla and then sanded.

Fix the batten, control panel support and rear panel fixing to each frame side panel followed by the batten on the frame front member. When set, apply adhesive to the ends of the frame front member, frame divider and frame top member and secure each in position with nails using the base panel to keep the assembly square. When set, glue and nail the base in position, having previously made the array of holes to suit the loudspeaker. This can be followed by the horizontal rear panel support. The centre support can finally be glued in position to complete the case frame.

In the prototype the Work Panel and Control Panel were made up from 3mm plywood and covered with Formica. These may be painted or varnished if preferred.

The bare plywood panels, should be tried in position on the framework, and if necessary their dimensions modified to fit neatly in their final positions. A gap of about 4mm should exist between Control Panel lower edge and frame divider to allow the wires to pass from the terminal blocks to control panel components. A slightly oversized piece of plastic laminate can be glued to the panels using Evo-Stik or Thixo Fix and when set filed down to size.

Only the drilling of the rear and control panels remains. With the latter, use of a sheet of self adhesive paper or a number of self adhesive labels strategically placed are advised for marking out the positions of the holes on this panel. Besides providing protection to the surface during this operation, the paper will also reduce any likelihood of the drill bit slipping as drilling starts.

NOTES ON DRILLING

It is advisable to wait until you have the Minilab components to hand before drilling the holes in the Control Panel. The diameters of the holes shown are for the particular components at hand when building our Minilab. It is possible that you may obtain alternative types of component which may not be exactly the same size as specified. Do not be tempted to rearrange the layout on the Control Panel. Space has been left for the modules to be added later.

Panel mounted components for the modules will not be at hand until later in the series, but it is advised that the holes to accommodate these are made at the same time as the others, before any components are mounted.

We believe it will be safe to go ahead and drill the three uppermost right hand holes the same size as that you drill for S4. Also the hole between VR2 and C1 the same size as VR2 fixing hole.

The rectangular cut-out in the panel is to suit a particular 7-segment display that will be uniquely defined later in the series. It is in order therefore to cut this aperature to the size shown.

METER CUT-OUT

A large circular cutter will be required for making the meter cut-out, its diameter to accommodate the meter rear moulding. Alternatively a ring of small holes may be drilled side by side around the internal circumference of the cut-out and a small saw blade used to cut between adjacent holes and then filed smooth using a half-round file. A fret saw may also be used to make the cut-out.

Fixing hole positions can then be determined and made with the meter sitting in the cut-out.

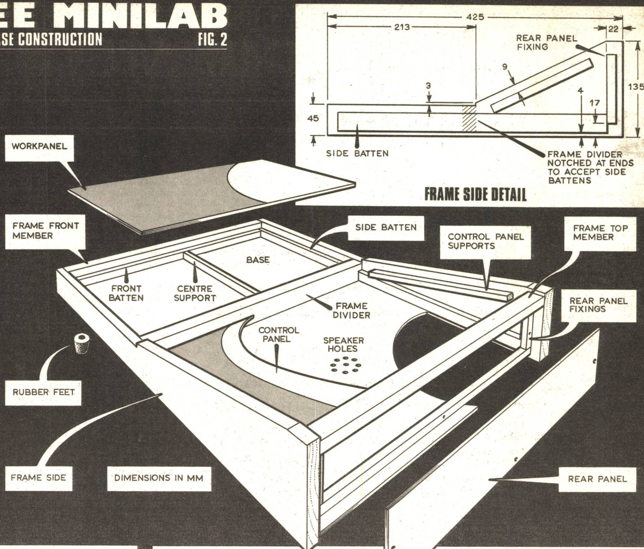
The rectangular cut-out is to accommodate a seven-segment display to be fitted later in the series and is easiest made by drilling two holes about 10mm diameter and then filing square. A file with an uncut edge is advised.

The two fixing holes for the variable capacitor should be marked and drilled using measurements taken from the capacitor supplied in your kit. Alternatively it can be glued using an adhesive such as Araldite.

Finally countersink the four panel fixing holes.

EE MINILAB

CASE CONSTRUCTION FIG. 2

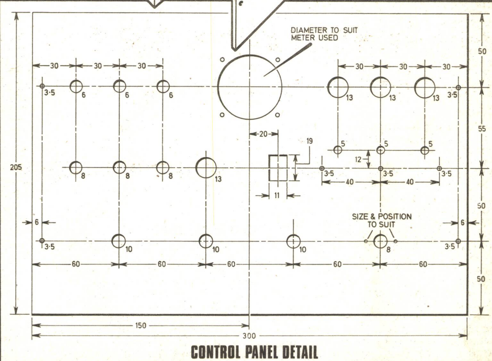


FRAME SIDE DETAIL

DIMENSIONS IN MM

CUTTING LIST

WORKPANEL	300 × 179 × 3 *Plywood*
	300 × 179 × 1 *Formica*
CONTROL PANEL	300 × 205 × 3 *Plywood*
	300 × 205 × 1 *Formica*
FRAME SIDES	425 × 135 × 14 (2) *Softwood*
FRAME FRONT MEMBER	300 × 45 × 14 *Softwood*
FRAME TOP MEMBER	300 × 22 × 14 *Softwood*
FRAME DIVIDER	300 × 40 × 18 *Softwood*
SIDE BATTENS	389 × 35 × 8 (2) *Softwood*
FRONT BATTEN	284 × 35 × 8 *Softwood*
CENTRE SUPPORT	163 × 35 × 8 *Softwood*
REAR PANEL FIXINGS	101 × 13 × 13 (2) *Softwood*
	300 × 13 × 13 *Softwood*
CONTROL PANEL SUPPORTS	165 × 13 × 13 (2) *Softwood*
BASE PANEL	397 × 300 × 3 *Plywood*
REAR PANEL	300 × 114 × 3 *Plywood*



CONTROL PANEL DETAIL

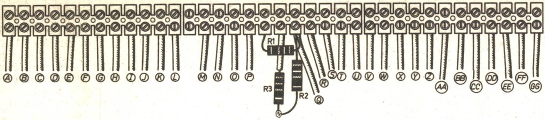


Fig. 3. Overhead view of screw terminal blocks showing wiring positions of leads from Control Panel mounted components. You can see the meter series resistors R1, R2 and R3 connected directly to the terminal block and secured by the terminal block screws. Solder R2 and R3 after they are secured to the block.

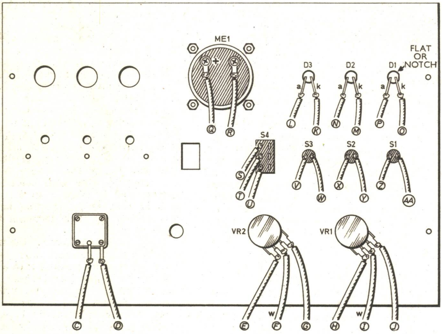


Fig. 4. Underside view of the Control Panel with all its components in place and wiring details to the terminal blocks. Connect *A* to *A*, *B* to *B* and so on.

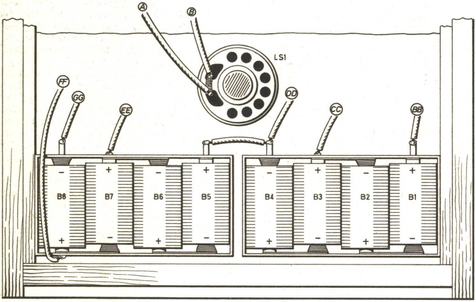
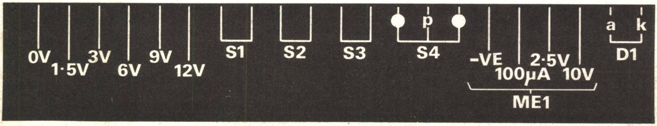
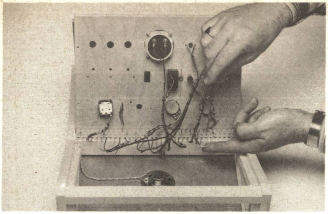


Fig. 5. Wiring details when using the lateral style battery holders showing connections to be made to the terminal block, see Fig. 3.

Fig. 7. Full-size label that may be cut out or copied and then glued on the Work Panel top edge to identify functions of terminal block positions.





Wiring to the terminal blocks with the Control Panel conveniently supported in an upright position.

For neater appearance, the underside of the control panel top edge was chamfered so that it fitted close up against the frame top member.

When this has been done, the fixing holes for this panel should be made in the panel supports using the Panel as a template.

The external framework can now be prepared and painted; gloss or varnish is considered more suitable than emulsion paint.

CONTROL PANEL LABELLING

It is recommended that all controls/indicators on the Control Panel are clearly labelled so that you know exactly which control to use during your experiments. This can be carried out with Letraset or similar rub-down lettering. The result with this method is seen in the photographs of our Minilab.

This is more easily done before mounting the components on the panel, but make allowance for protruding bushes, nuts and knobs which might cover the lettering when the items are in position. The lettering should be protected from wear by spraying with a clear lacquer such as Letracote.

Embossed labelling tape (for example, Label-Mate) may be used instead, but this and other "panel type labels" are better added after the items are mounted.

The coloured spots on the Control Panel are intended to help identify the settings of S4, VR1 and VR2. The spots may be painted on or you can punch discs from coloured card and stick them in place.

COMPONENT ASSEMBLY

Depending on which battery holders you have, wire up according to Fig. 5 or Fig. 6. Connect long enough leads to these to reach the terminal block positions when holders are in place. The holders should touch the inside face of rear panel support. These may then be screwed or glued to the base panel. Do likewise with the speaker.

With reference to Fig. 4 mount all the components in place on the Control Panel. It may be necessary to recess the Control Panel underside at locations D1, D2 and D3 to properly fix the l.e.d. clips/bushes, and S1 S2, S3 to allow the fixing nut of these switches to be screwed on.

Connect sufficient lengths of wire to these components to comfortably reach the terminal blocks.

All terminal block positions are to be labelled on the Work Panel top side. A two-part label, actual size is provided in Fig. 7 and may be cut-out (or copied) and glued centrally on the Work Panel. With this done, the terminal blocks may be screwed to the frame divider to align with these.

With the Control Panel supported as seen in the photograph, all leads should be trimmed, insulation cut back and the stranded wire twisted and tinned (coated with solder). Referring now to Figs. 3 to 6, secure each of the leads, including battery and speaker, to their terminal block positions.

It is important to connect the meter and l.e.d.s the correct way round. The meter will be marked with a "+" and a "−" to correspond with "100μA" and "−VE" on the terminal block.

The two leads from an l.e.d. are polarity conscious being known as anode(a) and cathode(k).

Also pay attention to connections from VR1, VR2 and S4 to avoid confusion during experiments later on.

The wires to C1 should be as short as possible and be as far as possible from any other wires.

Once you have checked and double checked the wiring, the Control Panel may be screwed in place and the batteries inserted. Pay special attention to cell polarity when doing this, see Fig. 5 (or 6). The rear panel may now be screwed on to complete the unit.

LEAD SET

A set of leads need to be made up to provide a means of interconnecting components on the breadboard and to the Control Panel components via the terminal blocks, see table below.

Quantity	Length (cm)
8	20
10	15
10	10
8	6
10	4

We recommend 7/0·2mm p.v.c. covered wire.

About 5mm of insulation should be stripped from each end, and the exposed strands twisted tightly together. Both ends should next be tinned to produce a suitable "plug" for inserting in the Verobloc "sockets". ⌑

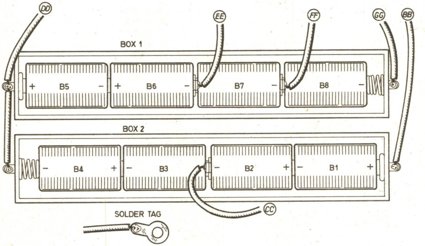
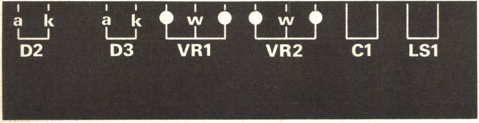
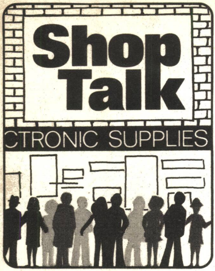


Fig. 6. Wiring of the alternative, in-line battery holders. With this type of holder, the tapping leads need to be fitted with a solder tag as shown. This is then pushed between the appropriate cells to make the tapped connection.





Shop Talk

By Dave Barrington

Special Offer

We strongly advise all our readers to take advantage of our Special Offer (see page 664) of a £1 off a Verobloc solderless breadboarding system module.

Apart from its use in the new Teach-In series, this Verobloc is suitable for most instant circuit experiments before being committed to a final "hardwired" version. Also it will repay for its self many times over in respect of damaged components through one cause and another.

Component Storage

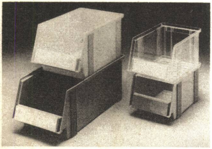
When considering items for the workshop one item that seems to be regularly overlooked is the component storage bin or rack. However, if we are to make serious attempts at keeping the work area "clutter free" then these are well worth the investment.

The price will, of course, vary according to whether you choose a single plastics or cardboard tray, or one of the multi-drawer cabinets available from most of our advertisers.

Available in three sizes and three colours, red, blue and yellow, the latest range of polypropylene storage bins from Link-Hampson are easily stackable and feature a corrugated inner base. The new base, it is claimed, makes it easier to pick up smaller components, such as glass diodes and transistors, from the bottom of the bins.

A moulded handle on the front of each "tray" has a slot for inserting an identification tab. Also, see-through bins are included in the range and have the advantage of displaying their contents at a glance.

Storage bins from Link-Hampson.



The largest of the polypropylene bins, 400mm × 156mm × 186mm deep, cost £2·05 and the medium size, 300mm × 156mm × 186mm deep, £1·65. The smallest bins, 250mm and 130mm × 149mm deep, cost 90p each.

The storage bins can be ordered direct or for addresses of nearest stockists write to Link-Hampson Ltd., Dept EE, 5 Bone Lane, Newbury, Berks.

Using their experience in providing document storage systems for banks, Bankers Box are now producing a range of fibreboard bins which make excellent low cost component storage trays.

This firm started by making document storage systems for banks, hence its name, but seeing possibilities in other fields it has applied its technical know how to broaden its range of products. The result is a flat-pack tray which folds into shape using no clips or staples. The folds are designed to provide plenty of strength and are grease resistant.

The bins come in seven sizes from 51mm wide by 102mm high by 305mm long up to 203mm × 102mm × 457mm. Available in packs of 10 the 102mm × 102mm × 305mm size usually retails at £3·75 per pack.

Further information can be obtained from Bankers Box, Dept EE, Doncaster Road, Kirk Sandall, Doncaster, DN3 1HT.

CONSTRUCTIONAL PROJECTS

Sustain Unit

Some of the components called for in the *Guitar Sustain* could cause readers buying problems.

First investigations reveal that it would appear only Watford and Electrovalue Electronics stock the 2N3820 field effect transistor (f.e.t.). The f.e.t. input op-amp type LF351 is stocked by Rapid, Watford, Maplin and Electrovalue.

Although the jack socket SK1 is listed as a standard type incorporating a double-pole double-throw switch this item is in very short supply. It does not appear in the Watford catalogue but we understand that they are able to supply this component.

Of course, there is no reason why a single-pole on/off toggle switch and a standard jack socket should not be used. The layout of components within the case will, of course, have to be altered.

Capacitance Meter

The multiturn cermet trimmer potentiometer (VR1) is available from most advertisers but check that it is of the correct physical dimensions for mounting on the circuit board. This component is fairly expensive and could be replaced by a standard skeleton miniature preset type of the same value.

However, for the sake of accuracy we recommend that readers use the components specified in the parts list.

EE Mini Lab and Teach-In '82

For those readers who will have to master the art of woodworking when tackling the *EE MiniLab*, there is no need for dispair as most of the components required for the first few experiments in the *Teach-In 82* series can be wired direct to the Verobloc "instant" circuit module.

A list of complete kit suppliers for the *EE MiniLab* (List 1) and components for the first six instalments of Teach-In 82 experiments (List 2) is set out in table below.

One of the reasons for the price variations (see relevent advertisements) is caused by component sourcing and the quality and type of the final selection of components used in making up the kits. This applies particularly to the meter, variable capacitor and battery holders.

Popular Designs

Most of the components called for in *Popular Designs* should be readily available from advertisers. We see that some of them offer an identical size piece of board in packs of five.

TEACH-IN 82 KIT SUPPLIERS

Supplier	LIST 1	LIST 2	LISTS 1 & 2
Bi-Pak *(p. 645)*	£15·65	£8·94	£23·00
Electrovalue *(p. 709)*	£16·56	£6·32	£21·79
Greenweld *(p. 699)*	£18·50	£8·10	£25·00
Magenta Electronics *(p. 700)*	£16·40	£9·34	£24·98
A. Marshall Ltd *(p. 696)*	£17·00	£12·50	£28·50
T. Powell *(p. 708)*	£19·75	£10·50	£26·50
T.K. Electronics *(p. 705)*	£19·50	£9·50	£27·50
Watford Electronics *(p. 641)*	£18·08	£9·33	£25·54

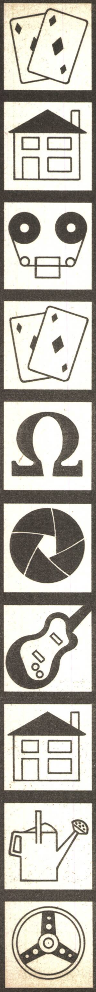
NOTE

(1) All prices are inclusive of VAT, postage and packing.

(2) If Vero coupon is enclosed deduct £1 from List 1 price quoted.

(3) Price quoted in last column applies only when Lists 1 and 2 are ordered *at the same time*. Deduct £1 from this price if Vero coupon is enclosed.

(4) For suppliers full address refer to page number following company name.



10

POPULAR DESIGNS

A COLLECTION of ten simple projects—comprising one from each volume of EVERYDAY ELECTRONICS 1971-1981. These have been selected to provide a wide range of subjects and fields of interest.

Any of these designs can be built on the piece of Veroboard (Stripboard) given with this issue.

CONTENTS

1 **Snap Indicator** 672

2 **Damp Locator** 673

3 **Tape Noise Limiter** 674

4 **Heads and Tails Game** 675

5 **Continuity Tester** 676

6 **Photo Flash Slave** 677

7 **Fuzz Box** 678

8 **Opto Alarm** 679

9 **Soil Moisture Unit** 680

10 **Ice Alarm** 681

Newcomers to electronics should refer to page ***682*** *for general information concerning construction of these projects.*

POPULAR DESIGNS

SNAP INDICATOR

1971/2

In some games, such as snap and question games, it is necessary to know which person or team is first, If recognition of pairs or readiness to answer is declared by voice, it is not always clear who was first.

The device described here was built to avoid this difficulty. Its simple electronic circuit is arranged so that when one person has pressed a button, a later response by the opponent is blocked; and an indicator lamp shows who was first. The circuit automatically returns to its original condition when the push-buttons are released, and hence is ready for the next turn.

CIRCUIT OPERATION

Transistors TR1 and TR2 act as switches for LP1 and LP2 that are in the collector circuits of the transistors.

One push-button is operated by each player and S3 is the on/off switch. Normally S1 and S2 are open and the transistor bases are held off and no collector current flows.

If S1 is now pressed, connecting R1 to the base of TR1, this shifts TR1 into conduction so that the indicator lamp LP1 lights. Almost the whole supply voltage is dropped across LP1, so that the supply voltage between the negative line and TR1 collector, R3 junction is very small. If S2 is now closed, TR2 will not be turned on since its base will not be taken positive enough. Hence LP2 will not light.

Should S2 be closed first, LP2 lights and LP1 cannot be lit.

Push-buttons S1 and S2 are bell-pushes, suitably placed for each competitor. The button is pressed and held down, to show recognition of pairs or readiness to answer. LP1 and LP2 are low-consumption bulbs (0·06A 6V) which limit collector current to a low value.

When both pushes are released, the circuit returns to the normal condition.

COMPONENTS

Resistors

R1 5·6kΩ R3 4·7kΩ

R2 4·7kΩ R4 5·6kΩ

All ¼W ± 10% carbon

Transistors

TR1, TR2 2N2926 silicon *npn*

Lamps

LP1, LP2 0·06A 6V bulb and holder

Switches

S1, S2 S.P.S.T. push button (bell push)

S3 S.P.S.T. toggle (on/off)

Miscellaneous

B1 4·5V torch battery

Veroboard: 10 strips by 12 holes 0·1in. matrix

P.V.C. covered connecting wire (7 strand coloured)

ASSEMBLY

The complete unit is housed in a small box, ours was a wooden box made up for the job, but almost any small box will do. Holes are cut for the two indicator lamps (LP1 and LP2), the on/off switch, S3, and the wires to S1 and S2.

The wires used to connect the circuit to S1 and S2 are twin core mains or bell wire.

If a metal case is used it is a good idea to cover the metal area under the component board with insulation tape.

For team games, leads to S1 can run to two or more pushes connected in parallel, and leads to S2 similarly to the required number of pushes.

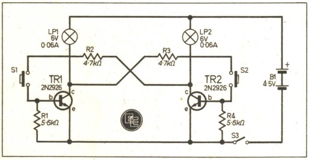


Fig. 1. Circuit diagram of the Snap Sequence Indicator.

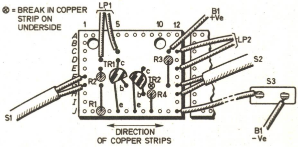

⊗ = BREAK IN COPPER STRIP ON UNDERSIDE
LP1
1
5
10
12
A
B
C
D
E
F
G
H
I
J
B1
+Ve
LP2
TR1
c
R3
S2
R2
TR2
b
R4
R1
e
S3
S1
B1
−Ve
DIRECTION OF COPPER STRIPS

Fig. 2. Veroboard layout and wiring diagram.

POPULAR DESIGNS

DAMP LOCATOR

1973

The device to be described is an inexpensive, simple, but effective, damp locator that will reveal damp in a variety of normally non electrically conducting materials such as stone, concrete, plaster, papers and textiles.

Since the device is intended to indicate a low level of dampness that is normally hard to determine by hand or eye, the use of a meter was not merited, and indeed by using an l.e.d. a fair portion of space and cost are saved.

CIRCUIT DETAILS

The two transistors, TR1 and TR2, are arranged in a configuration known as a Darlington pair. This arrangement has the property of providing extremely high gain—approximately equal to the multiplied gains of TR1 and TR2—with very high input impedance. Thus a small current flowing between TR1 base/emitter causes a very much larger current to flow between TR2 collector and emitter.

When the Damp Locator is placed upon a damp surface, a minute current is able to pass via that surface between the sensors. This small current provides the base bias for TR1 causing it to be in the conducting state and allows a larger current to pass through its collector and emitter to the base of TR2. This in turn allows TR2 to reach a state of conduction allowing a current to flow through the light emitting diode, D1, damp is indicated by the resultant glow.

In the absence of a conducting media between the sensors, the circuit draws negligible current from the battery, thus an on/off switch was not used on the prototype, the battery being removed during long periods of non use.

COMPONENTS

Resistors
R1 100kΩ R3 180Ω
R2 15kΩ ¼ watt ± 10% carbon

Capacitors
C1 0·01μF sub-miniature type

Semiconductors
TR1, TR2 BC108 or similar silicon *npn*
D1 TIL209 or similar light emitting diode

Miscellaneous
B1 5·6 volt Mercury type PX-23
Veroboard 10 strips 12 holes 0·1in. matrix; small transparent plastic box; 22 s.w.g. tinned copper wire. Connecting wire.

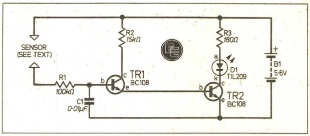


Fig. 1. The circuit diagram of the Damp Locator.

ASSEMBLY

The unit should be housed in a plastic box. A metal case is *NOT* suitable. The sensor is made from two parallel strips of 22 s.w.g. wire threaded through four holes drilled in the base of the box. The finished unit should appear to have a "railway track" running across the bottom outer surface of the case.

TEST

Carry out the following test. Hold the battery flying leads on the battery and touch the sensor lead (from *B4*) on the positive terminal of the battery. The diode should glow brightly. If this does not happen re-check and rectify.

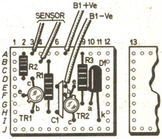


Fig. 2. The layout of the components on the Veroboard.

POPULAR DESIGNS

TAPE NOISE LIMITER

1974

INEXPENSIVE portable cassette tape recorders are extremely popular, but they usually have only a rather limited output power, driving a small internal loudspeaker, and the noise level is rather high.

The noise level cannot be entirely overcome, but a worthwhile improvement can be made by connecting the unit described in this article between the output of the recorder and the amplifier input.

CIRCUIT DESCRIPTION

Resistors R1 and R2 form a potential divider across the supply, and produce a low voltage supply for the field effect transistor, TR1. With only a small supply potential such as this, the d-s connections of the f.e.t. act as a simple resistor. With the gate terminal tied to earth via R4, its resistance is very low, at about 100 ohms, or even less.

Resistor R3, together with the d-s resistance of TR1, R5, and C3, forms an attenuator. The main complication is C3, as its reactance (its resistance to a.c.) varies with frequency. It has a reactance of approximately 50 kilohms at 100Hz, but of only approximately 500 ohms at 10kHz.

This means that the attenuation factor of the circuit changes with frequency. If one calculates the attenuation factor of the circuit at 100Hz, and 1kHz, it will be found to be a little over one, which is barely noticeable.

If it is calculated for 10kHz, it will be found to be almost exactly three, which is of course considerable, and will increase still further at high frequencies. This gives the required treble cut.

Some of the input signal is fed via C4, VR1, C6, and R6, to the base of TR2. This is a high gain common emitter amplifier, and the amplified signal is fed from TR2 collector, via C8 and R9, to a voltage doubling rectifier circuit, D1, D2, and C7. The resultant negative d.c. bias is fed to the gate of TR1.

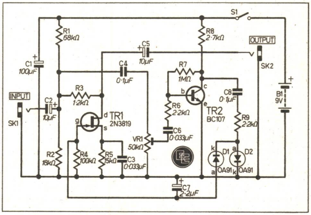


Fig. 1. Circuit diagram of the Tape Noise Limiter.

On low level signals, this bias voltage will have little or no effect, but on strong signals it will be large enough to cause the resistance of TR1 to be greatly increased, to as much as a few megohms. Components C3 and R5 are virtually switched out of circuit, and the treble cut is thus removed.

The tape hiss is less noticeable in the presence of high frequencies, than in the presence of low or middle frequencies; C4, C6, and C8 are given rather low values, so that the circuit responds more readily to high frequencies.

ASSEMBLY

Solder all the flying leads to the board; the leads should be about 70mm long insulated wire. The board should now be mounted in a suitable case by means of two 12mm long 6BA nuts and bolts. Finally, wire up the flying leads to the case-mounted components.

ADJUSTMENT AND USE

The "tape" or "radio" input of most amplifiers or record players has a fairly high input impedance (50 to 100 kilohms), and should be used. The unit can be used with amplifiers having fairly low input impedances (5 to 10 kilohms).

Potentiometer VR1 adjusts the level at which the treble cut is removed. Experiment a little using various settings. If this is set too high, tape hiss will be heard on low level signals.

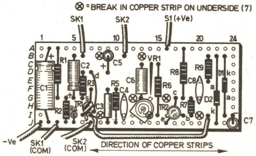


Fig. 2. Layout of components on the Veroboard.

COMPONENTS

Resistors

R1	68kΩ	R4	100kΩ	R7	1MΩ
R2	18kΩ	R5	15kΩ	R8	2·7kΩ
R3	1·2kΩ	R6	2·2kΩ	R9	2·2kΩ

All ¼ watt carbon + 10%

Potentiometer

VR1 50kΩ sub-miniature preset, horizontal

Capacitors

C1	100µF elect. 10V	C5	10µF elect. 10V
C2	10µF elect. 10V	C6	0·033µF
C3	0·033µF	C7	2·2µF elect. 10V
C4	0·1µF	C8	0·1µF

Semiconductors

TR1	2N3819 *n* channel f.e.t.
TR2	BC107 silicon *npn*
D1, D2	OA91 (2 off)

Miscellaneous

B1	PP3 9V battery
SK1, 2	3·5mm Jack socket (2 off)
S1	s.p.s.t. rotary switch

Veroboard: 0·1in. matrix; battery clips for PP3; aluminium case 135 × 70 × 40mm with removeable lid; control knob.

POPULAR DESIGNS

HEADS & TAILS GAME

1975

This simple little novelty device demonstrates how it is possible to electronically simulate the tossing of a coin.

The circuit is arranged so that it is purely a matter of chance whether the heads or tails lamp is illuminated when the push button is pressed, the circuit thus providing the same effect as tossing a coin.

CIRCUIT OPERATION

The two indicator lamps are two light emitting diodes (l.e.d.s), D1 and D2. These are protected against passing excessive currents by the series resistors R1 and R4. Diode D1 is illuminated when TR1 is turned on, and D2 will be illuminated when TR2 is turned on.

If VR1 is ignored for the time being, when the push button switch, S1, is depressed, the positive supply will be connected to the circuit. The transistors will obviously both begin to turn on, TR1 receiving its base bias current via R4, D2, and R3, and TR2 receiving its base current via R1, D1, and R2.

It is, however, not possible for both transistors to turn hard on at the same time, as if TR1 is turned hard on, only a fraction of a volt will appear at its collector, and TR2 cannot receive the necessary bias current to turn hard on. If TR2 turns hard on then the same is true for TR1.

What happens when the supply is connected is that both transistors begin to turn on, but due partially to chance, and partially to a slight unbalance in the resistor values, transistor gains, etc. of each half of the circuit, one will begin to turn on faster than the other. In doing so it tends to starve the other transistor of base current as its own collector swings towards earth potential.

On the other hand this enables it to obtain a heavy base current from the collector of the other transistor, as this has its collector still at virtually the full supply potential. This regenerative action results in one transistor being biased to saturation, and the other being cut off. Obviously only only of the lamps will light up.

COMPONENTS

Resistors
R1 470Ω R3 82kΩ
R2 82kΩ R4 470Ω
All $\frac{1}{4}$W carbon ± 5%

Potentiometer
VR1 1kΩ horizontal skeleton preset

Semiconductors
TR1, TR2 BC109 silicon *npn*
D1, D2 TIL209 or similar l.e.d. with holder

Miscellaneous
S1 push-to-make, release-to-break push-button switch
B1 9V PP3 with connector
Veroboard: 0·1 inch matrix size 10 strips by 24 holes; case.

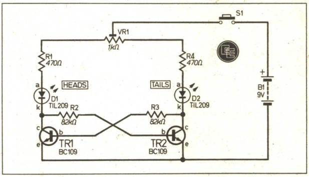


Fig. 1. The circuit diagram of the Heads & Tails Game.

VR1, compensates for the component tolerances by supplying a higher supply voltage to one or other side of the circuit, and is adjusted by trial and error.

ASSEMBLY

Connect up the l.e.d.s and S1 using approx. 75mm lengths of thin insulated wire. Make quite sure that the l.e.d.s are connected with the correct polarity.

The front panel of a suitable case should next be drilled to take S1 and the diodes. Switch S1 is mounted in the centre of the panel, and the l.e.d.s are mounted to the right of this, one above the other.

ADJUSTMENT

Start with the slider of VR1 at a central position and then press S1 a number of times (25 or more). It will probably be found that one lamp lights up much more often than the other. If D1 lights up more frequently, then VR1 should be adjusted slightly in an anticlockwise direction to compensate for this. If D2 lights up more frequently, then VR1 needs to be adjusted slightly in a clockwise direction.

Repeat this procedure until the circuit is properly balanced with each lamp lighting up approximately the same number of times.

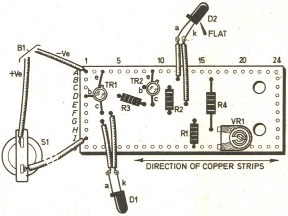


Fig. 2. Stripboard component layout.

POPULAR DESIGNS

CONTINUITY TESTER

1976

When building and servicing electronic equipment, there are numerous occasions when some form of electrical continuity tester is required. It may be when tracing out the wiring around a complicated array of switches, or perhaps something more everyday such as checking for a break in a mains cable; sorting out the contacts of a wavechange switch; or checking a fuse which one suspects has blown.

The very simple tester described here produces an audible tone to indicate continuity. The unit is very simple to construct and is also quite inexpensive as few components are used.

CIRCUIT OPERATION

The circuit consists of a relaxation oscillator, feeding a miniature speaker.

A unijunction transistor, TR1 forms the active component in the oscillator. Unijunction transistors have little in common with ordinary bipolar transistors except that they are also three terminal devices. The terminals are named differently though, being called base 1 (b1), base 2 (b2) and emitter (e).

With no voltage present at the emitter, the base 1 and base 2 terminals have a resistance of about three to 10 kilohms across them. Therefore, when the test prods are short-circuited, a current of about a couple of milliamps will flow through the loudspeaker via the unijunction.

This does not, of course, take into account that C1 will have charged to the supply potential within a fraction of a second of the battery being connected and so there is about 9V at the emitter of TR1.

If more than about half the supply potential is present at this terminal the emitter input impedance (which is otherwise extremely high) suddenly falls to a very low level and the base 1 to base 2 resistance of the device falls to about half its previous level.

Thus, at the instant the test prods are touched together, C1 discharges into the emitter of TR1 and a pulse of current is fed to the loudspeaker via the b1, b2 terminals of TR1.

Once C1 has largely discharged, TR1 operates as previously described until C1 is charged via R1 to the trigger voltage once again. Then C1 will again discharge and another pulse of current will be fed to the loudspeaker. This will continue in rapid succession causing a continuous tone to be emitted from the loudspeaker as long as the test prods are connected together.

If a resistance of more than a few hundred ohms is present between the two test prods, TR1 will cease to function and no audio tone will be generated,

COMPONENTS

Resistor
R1 6·8kΩ ± 10% ¼W carbon
Capacitor
C1 0·22µF polyester type C280
Transistor
TR1 TIS43 unijunction transistor
Miscellaneous
LS1 25 to 80 Ω speaker
B1 9V PP3 battery
Veroboard 0·1in matrix; 10 strips × 11 holes; aluminium box; test leads and prods; speaker fret; PP3 battery connector.

ASSEMBLY

Virtually any small case can be used to house the unit, the minimum suitable size being about 100×70 ×25mm.

CONCLUSION

When using the unit it should be borne in mind that if the circuit under test has a resistance of perhaps as much as several hundred ohms the unit will still produce an audio tone even though there is not true continuity. This is not a major drawback however as, if the resistance between the prods is more than just a few ohms, the volume of the tone drops and the type of note changes noticeably.

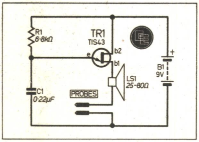


Fig. 1. The complete circuit diagram of the Continuity Tester.

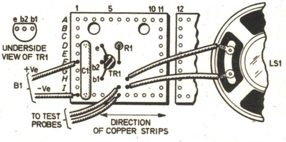


Fig. 2. Layout of components on Veroboard and complete wiring details.

POPULAR DESIGNS
PHOTO FLASH SLAVE
1977

There now seems to be a very wide range of electronic aids available to photographers, and most such aids appear to be fairly complex devices. Although a photo-flash slave unit is probably the most simple of these devices it is nevertheless one of the most useful.

A flash slave unit triggers a secondary flashgun when it receives a pulse of light from the main flashgun.

CIRCUIT OPERATION

A thyristor is a unilateral device, and it will therefore only function properly if it is fed with a voltage of the correct polarity. In order to avoid any problems here, a bridge rectifier consisting of D2 to D5 has been added in series with the flash lead, and this provides a signal of the correct polarity to the thyristor (CSR1) regardless of which way round the flash lead is connected.

Resistors R2, R3, and diode D1 form a simple Zener shunt regulator, and these limit the voltage which can be fed to the gate of CSR1 via the photo-Darlington amplifier TR1. Capacitor C1 is needed in order to provide the current required to trigger CSR1.

While C1 charges up it is receiving a current of only a few microamps for about one second. When the light from the main flashgun is received by the photocell (TR1), it's normally very high resistance falls to a level of only about a few hundred ohms. This happens extremely quickly, and as a result C1 almost instantaneously discharges through TR1 and into the gate of CSR1. Because the charge on C1 is released so rapidly, the discharge current is many times greater than the charge current. It is thus sufficient to switch on CSR1 which then places a low impedance path across the flash lead and so fires the flashgun.

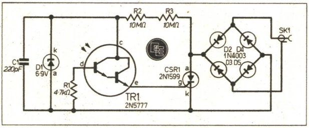


Fig. 1. Complete circuit diagram of the Photoflash Slave Unit.

COMPONENTS

Resistors
R1 4·7kΩ   R2 10MΩ   R3 10MΩ
All resistors are carbon ¼W ± 10%

Capacitors
C1 220nF polyester

Semiconductors

TR1	2N5777 photo darlington *npn*
CSR1	2N1599 200V 1A invristor or equivalent
D1	BZY88C6V8 6·8V 400m W Zener
D2-D5	IN4003 rectifier (4 off)

Miscellaneous
SK1 extension lead for flash gun
Small transparent plastic case, 50mm × 40mm × 25mm; stripboard 0·1 inch matrix 10 strips × 12 holes; small rubber grommet; solder.

After the flashgun has gone off the current through CSR1 falls to virtually zero and this component switches off. The circuit is then ready to start a fresh cycle when the flashgun is recharged again.

ASSEMBLY

The unit should be housed in a small transparent plastic case.

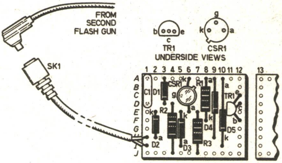


Fig. 2. Complete wiring diagram of the unit.

POPULAR DESIGNS

FUZZ BOX

1978

The pop musician is being constantly bombarded with new and improved musical effects units, but still polling high in the popularity charts is the "old" Fuzz Box.

CIRCUIT DESCRIPTION

Input to the unit is at SK1 a stereo jack socket wired to complete the d.c. power circuit when the input jack is inserted. The signal then passes to the op-amp via d.c. blocking capacitor C1. Resistor R1 sets the input impedance at 100 kilohms which should suit most guitars and electronic organs.

The gain of the sustain 741 op-amp is controlled by feedback and is equal to: (VR1 + R2 + R3)/R2. With specified values gain is from 6 to 92, depending on the setting of VR1. However, all output signals are limited to 600mV peak by the effect of D1, D2 in the feedback chain. VR1 setting controls the rise time of the signals towards the diode clipping level and thus the high order harmonic content in the signal which determines the depth of fuzz.

The resulting signal from the op-amp is reduced in amplitude by the potential divide action of R6 and R7, giving an attenuation factor of approximately four. Thus the maximum output signal via C3 available for inputting to an amplifier is about 150mV. This level will be maintained during the period of clipping (fuzz) and will then decay naturally to zero.

The 741 requires a split supply and this is derived by the potential divide action of R4 and R5 producing ±4·5 volts with respect to the op-amp reference line which is decoupled by C2.

A foot-switch S1 is incorporated to allow the unit to be readily by-passed when desired.

ASSEMBLY

The assembled stripboard, Fig. 2 was mounted horizontally in a die-cast aluminium box.

COMPONENTS

Resistors

R1	100kΩ	R4	10kΩ	R6	3·3kΩ
R2	1·2kΩ	R5	10kΩ	R7	1kΩ
R3	10kΩ	All ¼ watt carbon film ± 10%			

Capacitors

C1, C3	0·1μF plastic or ceramic
C2	10μF 6V elect.

Semiconductors

IC1	741 operational amplifier 8 pin d.i.l.
D1, D2	1N4148 or similar silicon diode

Miscellaneous

SK1	standard stereo jack socket
SK2	standard jack socket
S1	s.p.d.t. successional action foot-switch
B1	9V PP3
VR1	100 kilohm carbon lin.

Stripboard: 0·1 inch matrix 13 strips × 21 holes; PP3 battery clip; aluminium diecast box; knob for VR1; connecting wire.

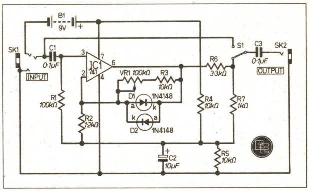


Fig. 1. The complete circuit diagram of the Fuzz Box.

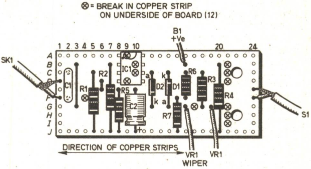


Fig. 2. Layout of components on the stripboard.

Attach the flying leads including the battery connector, Fig. 3, and then proceed with drilling the case.

Screened lead should be used for input and output connections.

A much harsher fuzz can be produced by connecting a 1 kilohm resistor across SK2, signal to earth.

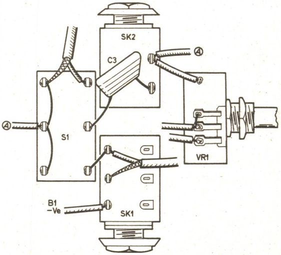


Fig. 3. Interwiring details. To be fitted in a metal box.

POPULAR DESIGNS

OPTO ALARM

1979

THIS simple single-transistor circuit is designed to sound a miniature audible warning device when light falls on to a photocell. The photocell is normally mounted in a dark room and the alarm is triggered when either the room lights are switched on or possibly when light from an intruder's torch falls directly on to the photocell.

CIRCUIT DESCRIPTION

The photocell PCC1 is an ORP12 light-dependent resistor which is located in the room to be protected, and is connected by means of PL1 and SK1. Together with R1, PCC1 forms a potential divider: the voltage at the junction of R1 and PCC1 varies with the amount of light striking the l.d.r.

In absolute darkness the resistance of an ORP12 is at least 10 megohms, and so the voltage at the junction of R1/PCC1 is very nearly that of the supply rail, 9V. Transistor TR1 is therefore firmly switched off as its base is not biased.

When light falls on PCC1, its resistance drops (albeit relatively slowly) and this causes TR1 to switch on. A triggering pulse is therefore delivered to the gate of CSR1 and this component conducts. The audible warning device (WD1) will therefore sound.

The thyristor will now remain in this low impedance state even if the triggering signal is removed. The only way to reset CSR1 and mute the alarm is to switch off the power supply. Resistor R5 will ensure that a minimum holding current is flowing in the anode-cathode circuit of the triggered thyristor, and so preventing any undesirable resetting.

ASSEMBLY

The prototype was built into an ABS "Bimbox" type 4003. This measures approximately 85×55×35mm and has an aluminium front panel.

There should be no problems with the construction of the circuit; Fig. 2 illustrates the recommended arrangement of components.

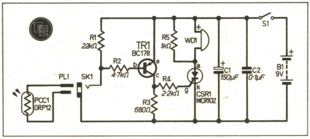


Fig. 1. The circuit diagram of the Opto Alarm.

COMPONENTS

Resistors

R1 22kΩ R3 680Ω R5 1kΩ
R2 4·7kΩ R4 2·2kΩ
All ¼W carbon ± 5%

Capacitors

C1 150µF16V elect.
C2 0·1µF polyester C280 or similar

Semiconductors

TR1	BC178 silicon *pnp*
CSR1	MCR102 thyristor rated 30V 0·8A or at least 9V 100mA
PCC1	ORP12 or similar light dependent resistor

Miscellaneous

SK1	3·5mm jack socket (2 off)
PL1	3·5mm jack plug
WD1	miniature 9V audible warning device

Stripboard: 0·1 inch matrix, 10 strips × 24 holes; case BIM 4003 or similar; twin-core flex; stranded connecting wire; 6BA fixings including 5mm spacers; 9 volt battery and connector; on/off switch.

All interconnections between the component board and front panel can be completed with stranded flexible hook-up wire.

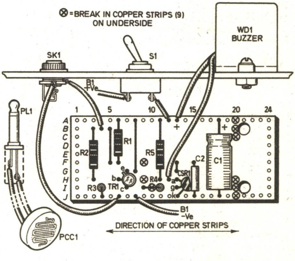


Fig. 2. The layout of the components on the topside of the stripboard

POPULAR DESIGNS

SOIL MOISTURE UNIT

1980

This device has partly a novelty value, but also definitely does give some indication of when the soil that it is measuring is "wet" or "dry". It may therefore help to give more consistent and successful results, assisting those who don't have much luck with potted plants.

CIRCUIT DESCRIPTION

Most of the work is done by IC1, a cheap and readily available 741C op-amp.

The variable resistor VR1, is wired between the supply lines and its wiper is connected to the inverting input. The setting of VR1 therefore determines the voltage at pin 2, and this can be altered from +9V to 0V.

At the non-inverting input we have the same sort of thing. The two probes, when inserted into soil, in effect form a resistor. The value of this "resistor" is dependent upon the moisture within the soil: the more moisture there is, the lower the value of this resistance.

Assuming that VR1 is at mid-position, when the soil is wet, we can say that the voltage at pin 3 will be lower than at pin 2. Therefore the output of IC1 is low. Current can therefore flow through R2 and D1, and "sink" into the output pin causing the green l.e.d. to light up. This is labelled WET.

Similarly with dry soil, the high resistance of the soil ensures that pin 3 is at a greater voltage than pin 2. The output pin therefore swings high, and it allows current to flow through the red l.e.d. D2 and R3 to 0V lighting up this l.e.d. This is labelled DRY.

ASSEMBLY

A Bimbox type BIM2002/12 houses the unit. This handy-sized box measures 100×50×25mm.

Any other plastic case can be used.

The two probes are made of 4BA threaded brass rod about 120mm long. Connections to the probes are made by solder tags placed under the mounting nuts within the case.

The two light-emitting diodes can be secured in position with either an appropriately-coloured lens-clip or a standard plastic fixing clip.

COMPONENTS

Resistors

R1 5·6kΩ R2 470Ω R3 680Ω

All ¼W carbon ± 5%.

Semiconductors

IC1	741C 8-pin d.i.l. operational amplifier
D1	TIL221 0·2 inch green l.e.d.
D2	TIL220 0·2 inch red l.e.d.

Miscellaneous

VR1	10kΩ miniature horizontal skeleton preset
S1	single-pole push-to-make, release-to-break
B1	9V type PP3

0·1 inch matrix stripboard; 10 strips by 24 holes; case, 100 × 50 × 25mm, Bimbox BIM2002/12 or similar; battery connector; 4BA fittings, threaded brass rod for probes; 8 pin d.i.l. socket; connecting wire; mounting clips for D1 and D2.

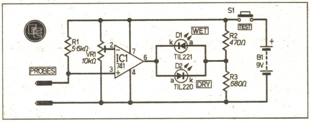


Fig. 1. Circuit diagram of the Soil Moisture Unit.

SETTING UP

With construction completed, set VR1 to approximately midway, connect up a battery and press S1. The red l.e.d. should glow. Bend the two probes together at their tips so that they short together: the red lamp should extinguish and the green l.e.d. illuminate.

If this happens the unit is ready to use. Set VR1 to give the desired switchover point of the two indicators. Here it may prove useful if you have some small containers of soil available. The individual samples should have various levels of water content, ranging from dry to saturated. It should then be possible to eventually adjust VR1 until a desired sensitivity is obtained.

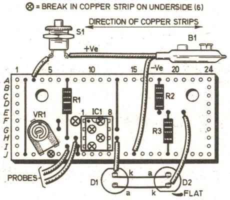

⊗ = BREAK IN COPPER STRIP ON UNDERSIDE (6)
DIRECTION OF COPPER STRIPS
S1
B1
+Ve
-Ve
1
5
10
15
20
24
A
B
C
D
E
F
G
H
I
J
R1
R2
VR1
1
IC1
8
R3
PROBES
D1
k
a
a
k
D2
FLAT

Fig. 2. Stripboard layout and interwiring diagram.

POPULAR DESIGNS

ICE ALARM

1981

THIS Ice Alarm warns the driver when possible conditions exist for the formation of black ice. It does this by monitoring the temperature outside the car. When this drops to about two or three degrees Celsius, slightly above freezing, the unit flashes a warning lamp on the dashboard.

CIRCUIT

The heart of the unit is IC1, a CMOS multivibrator which has been wired up as a gated astable. This means that the device oscillates only when pin 5 is high, otherwise it is inoperative.

Along with R1 and VR1, the thermistor forms a potential divider, the output of which is connected to the base of TR1.

If TR1 is on, pin 5 is high and so the i.c. oscillates freely. If the transistor is off, however, the reset pin is grounded through R2 and so the i.c. is disabled.

As the temperature of RTH1 decreases towards 0°C, its resistance will increase and the voltage at TR1 base will be reduced. Eventually a point is reached where the base terminal is 1·2V less than the emitter and so TR1 must turn on. Pin 5 of IC1 goes high, permitting it to oscillate normally; pin 11 then presents a square wave signal to TR2 and this causes the indicator lamp to flash.

Note that the lamp is normally fully alight to show that the Ice Alarm is on, but it flashes when RTH1 detects a low temperature.

Connections for the power feed and thermistor are taken by flying leads from the stripboard, through the case to a four-way screw terminal block mounted outside the case.

INSTALLATION

Ascertain whether the car chassis is positive or negative earth and connect this to the positive or negative terminal on the terminal block. The other supply wire should come from an ignition-controlled circuit (possibly at the fusebox), so that the Ice Alarm is not inadvertently left switched on when the ignition is switched off.

The position of the thermistor module may be rather a trial and error affair. The unit is obviously not waterproof and so it must not be exposed to spray or road filth. Furthermore it needs to be placed away from the car's exhaust system and cooling system—parts which get hot during normal operation.

Final positioning must vary from car to car. A suggestion is behind (i.e. inside) the front bumper.

COMPONENTS

Resistors

R1 82kΩ R3 470kΩ R4 680Ω
R2 22kΩ All ¼W carbon 10%

Capacitors

C1 0·1µF tantalum bead 35V
C2 0·22µF polyester C280

Semiconductors

IC1	CD4047 CMOS mono/astable multivibrator
TR1	MPSA65 *pnp* silicon Darlington
TR2	BFY50 *npn* silicon

Miscellaneous

VR1	47kΩ miniature horizontal preset potentiometer
RTH1	VA1066S negative coefficient rod thermistor
LP1	14V 40mA integral type MA lamp (amber)
S1	push-on, push-off single pole switch

Case, 110 × 60 × 30mm, Bimbox type 2003/13 or similar; stripboard, 0·1 inch pitch, 10 strips × 24 holes; 14 pin d.i.l. socket for IC1; four-way screw terminal block; piece of tagstrip for mounting RTH1; twin core flex, mounting hardware for circuit board; lamp holder for LP1.

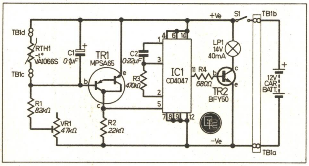


Fig. 1. Full circuit diagram of the Ice Alarm.

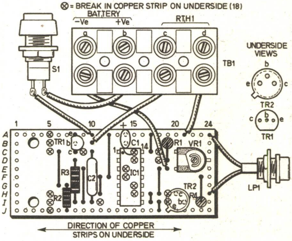


Fig. 2. Circuit board layout and component inter-wiring. Note that the thermistor RTH1 is not shown in this diagram but is connected to the terminal block via a long cable and located at some remote location.

CONSTRUCTION GUIDE

1 Any one of these **Popular Designs** can be built on a piece of stripboard (Veroboard) measuring $1\frac{1}{16}$in by $2\frac{3}{8}$ in, or 10 strips by 24 holes, such as the piece of board given free with this issue. Further boards of this size can be obtained from retailers advertising in this magazine.

2 Before attempting to build one of these **Popular Designs,** read carefully the article and study the circuit diagram and the component layout diagram. Note the method of coding the strips (letters) and holes (numbers) of the stripboard. This helps positive identification of connection points on the board. See Fig. 1.

3 Make any required breaks in the copper strips as indicated in the diagrams. This operation is performed using a twist drill (hand held); or with the aid of a special tool which can be purchased. See Fig. 2.

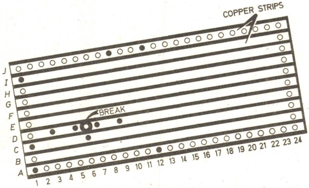


Fig.1

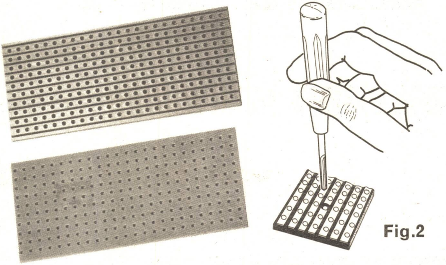


Fig.2

4 Solder in position the resistors, capacitors and semiconductors. Carefully check the identity of the semiconductor lead out wires, also the polarity of electrolytic capacitors, before placing in position. It is advisable to use a heatsink when soldering semiconductor leads. I.C. sockets are recommended for the mounting of these devices.

5 Any other components such as potentiometers and switches that are mounted externally to the stripboard should be connected to the appropriate points on the stripboard as indicated. Use insulated (preferably flexible) wire of sufficient length to suit the mounting arrangements and general assembly of the complete unit.

6 Note any special recommendations regarding the housing of the project, and the fixing arrangements for the stripboard within the case. Where a plastic (non-conductive) case is specified do NOT use a metal one.

SIMPLE INFRA RED REMOTE CONTROL

Pulsed beam gives high efficiency and strong peak output using a single l.e.d. Receiver uses a special i.r. photodiode that does not respond to visible light. The receiver energises a relay which can be used for switching electrically operated apparatus. The i.r. remote control could also be applied as a burglar alarm.

LOUDHAILER

A self-contained electronic megaphone unit built around an LM380N audio i.c. and designed to feed either a small conventional loudspeaker or a horn speaker. The output power of 1W is adequate for many applications and enables the unit to operate for long periods from small batteries.

TRANSISTOR IGNITION

This solid state replacement for the conventional car ignition system will improve m.p.g., extend spark plug life, minimise points wear and reduce demands on starter motor and battery.

NOVEMBER 1981 ISSUE
ON SALE FRIDAY, OCTOBER 16

EXPERIMENTAL CRYSTAL SET

A fascinating starter project for beginners of all ages. Easy to build and inexpensive in parts. Home-made coils cover medium and short waves.

Everyday News

ELECTRONICS AND MICROELECTRONICS

RADIO ELECTRONICS FOR SCHOOLS

With a new school term just starting it's a bumper month for the hard pressed physics teacher who, due to lack of qualified electronics teachers, is the one person invariably "press-ganged" into running the school's electronics classes.

Not to worry! Hard on the heels of our new beginners *Teach-In 82* series comes news that, under the School Radio banner, the BBC Radio 4 will be starting on September 22 a sound plus vision series for the teaching of electronics in secondary schools, including practical work. With our new series and the radio broadcasts, this should keep the pupils happy and relieve some of the pressure from the teacher.

The arrival of this more ambitious project from BBC School Radio entitled *Electronics and Microelectronics* is aimed at the 14 to 16 year olds and is designed to introduce some of the developments which have taken place in the last ten years.

The series consists of ten programmes and are accompanied by five Radiovision film strips. Also complete pupils' kits of component parts incorporating three transistors, two integrated circuits and a special softwood base (which take woodscrews for non-soldering experiments) are available. It is claimed that each kit is suitable for 3 or 4 pupils and costs £7·95.

Full details of how to obtain the kit and the filmstrips (which cost £5·70 each) are included in a 24-page Teacher's Notes booklet. These notes which contain master copies of pupils' worksheets, are available Free from "Electronics and Microelectronics" BBC School Radio, 1 Portland Place, London W1A 1AA, on receipt of a A4 self-addressed envelope stamped at 20p.

In collaboration with this BBC School Radio project BP Educational Service is producing a teachers handbook entitled *Microelectronics: Practical Approaches for Schools and Colleges.* The book is meant to complement the radio series by offering detailed guidance on choosing equipment and projects which demonstrate practical circuits.

The book, price £2·75, is available from BP Educational Service, PO Box 9, Wetherby, West Yorkshire LS23 7EH.

Electronics and Microelectronics is produced by Arthur Vialls. The series can be heard on Radio 4 VHF on Tuesdays, at 2.20-2.40 p.m., starting September 22.

MAPLIN ROADSHOW

At the end of September '81 Maplin are taking the Atari personal computers and their new Matinee Organ to five cities in the UK. This is a golden opportunity for mail order customers or anyone for that matter to actually see and handle these popular products and ask questions on the spot.

A warm welcome (between 6 pm and 10 pm) awaits anyone wishing to enjoy a pleasant informal evening which is completely free, so make a note of the following dates in your diary:

Newcastle upon Tyne, *Friday, September 25,* at the Grainger Room, Newcastle Centre Hotel, New Bridge Street, Newcastle upon Tyne.

Edinburgh, *Saturday, September 26,* at the Rosebery Room, Grosvenor Centre Hotel, Grosvenor Street, Edinburgh.

Manchester, *Sunday, September 27,* at the Ullswater Room, Portland Hotel, 3 Portland Street, Piccadilly Gardens, Manchester.

Birmingham, *Monday, September 28,* at the Malvern Suite, Birmingham Centre Hotel, New Street, Birmingham.

Norwich, *Tuesday, September 29,* at the Riverside Suite, Hotel Nelson, Prince of Wales Road, Norwich.

For your ENTERTAINMENT

By BARRY FOX

Talking Memories

A radio receiver and a television set which took the art of speech synthesis and recognition a stage further was demonstrated by Toshiba at a recent trade show. Although the prototypes are not in themselves to be taken too seriously they provide a useful pointer to the future.

The radio receiver is a fairly conventional hi fi unit, but it can be operated under voice control. Although interesting this, in itself, isn't new. Last year Toshiba was showing a television set that operated under voice control. You tell it to switch on, switch off and change channels. The new receiver is important because it can memorise, and mimic, up to ten phrases, each of two seconds in length.

To "teach" the receiver to do what you want, you speak command phrases into a microphone while microprocessor and memory chip store a digital coding of the words and dialect. Each stored phrase is then delegated to a switched function of the receiver.

For instance if you speak the phrase "BBC Radio 4", the microprocessor and memory store the sound of your voice saying those words. If you delegate that stored command to switch to the frequency for BBC Radio 4, then whenever you subsequently shout "BBC Radio 4" at the receiver it will recognise the command and switch to the appropriate frequency.

The breakthrough is in storage *capacity*. Ten phrases of two seconds each is a 20 second speech store. And as well as recognising the memorised phrases, the receiver can also speak them out as a check on what is memorised.

This points to the imminence of much larger solid state speech stores, programmable by the user. Imagine for instance a telephone answering machine on which the master message is recorded on a solid state memory, rather than a clumsy endless tape loop.

Talking TV

The other Toshiba development is a TV set which talks to the viewer. This is a digitally stored voice which is pre-programmed to speak appropriate phrases at user-selected times. For instance a timer will switch the TV on in the morning with an alarm call and a spoken "Good morning" at any chosen time.

At night the set will switch itself off at a pre-appointed hour with a "Now I'll fade out—have a goodnight's sleep". If you turn the volume up too loud the solid state voice (in the prototype a very female voice) advises you to "remember the neighbours, lower the volume".

An ultrasonic ranging device (not photoelectric as wrongly reported elsewhere) senses if anyone in the room is too close to the set. The voice then warns "Watch from a distance, for your eyes' sake".

The ultrasonic sensor also detects when everyone has either left the room, or moved out of range of the set. "Now I'll fade out", says the synthesised voice and the set switches itself off.

Chatter Box

It now looks as if we shall get legal CB radio on 27MHz f.m. any day now.

If recent experience in both Germany and Austria is anything to go by, it will rapidly become a craze, but a short-lived craze. The sad truth is that CB—even on f.m.—only "works" while the system is illegal and its use is restricted to those who are prepared to risk breaking the law. As soon as the system becomes legal, the electronics industry floods the market with cheap sets and these are heavily advertised. The number of CB users increases dramatically and very soon no one can get a word in edgeways over the air.

Journalists from Germany and Austria have told me that the airwaves there are now so cluttered with CB shouting that useful communication is impossible.

Pacemaker

When King Khaled visited London in the early summer of 1981, there was much publicity given for his heart ailment and the need for constant communication with his private surgeon in the USA. The word went round Fleet Street that King Khaled wore a miniature transmitter which provided a direct link with a machine in an American hospital continually monitoring his heart beat.

It was rumoured that King Khaled's personal transmitter beamed signals up to a satellite, from where they were beamed down again to the hospital. "Money can buy anything these days", said the political correspondents, "Nonsense" said the science correspondents," satellite transmitters are too big to hide in your clothes."

We'll probably never know whether King Khaled was or was not hooked up to a heart monitoring machine in America, but it was certainly technically possible, despite what the science correspondents told their editors. The clue is to be found in an erudite article published in *The Radio and Electronic Engineer*, official journal of the IERE (Institution of Electronic and Radio Engineers). The article, titled "Manpack Satellite Communications Earth Station" was by coincidence published at almost exactly the same time as King Khaled visited the UK.

Manpack Station

To cut a long, technical story short the Royal Signals and Radar Establishment in Worcestershire has now built a prototype ground station for satellite communication which can be carried as a military back-pack. Normally satellite linked gound stations are either permanent, with large dish aerials secured to the ground, or are mounted on a lorry. This is because the dish for such a ground station is around 2 metres in diameter and the transmitter is of between 30 and 60 watts power needing either a mains or generator supply to drive it.

The RSRE manpack station is just 45cm × 45cm × 20cm in size, weight 17 kilos and draws only 30 watts of power from a battery. The aerial dish is built into the case and measures only 45cm in diameter. The system transmits either low quality analogue speech or a 50 baud telegraph signal.

Although the unit is small enough for one man to carry around on his back, it isn't used as a mobile back-pack. To transmit, the unit is dumped onto the ground and aligned with a sky satellite using its built-in compass and signal strength meter.

It would have been perfectly possible for for King Khaled to wear a radio microphone, of the type now routinely used by performers in TV studios, strapped close to his heart. This radio mic would transmit heart beat signals over a short distance to a back pack satellite earth station in constant contact with the American heart hospital.

As I said we've no idea whether or not King Khaled actually used such a system, but it was certainly dangerous for Fleet Street science correspondents to dismiss the idea out of hand. But then, my experience of Fleet Street science correspondents is that some of them are remarkably naive about up-to-date science.

RADIO WORLD

By Pat Hawker, G3VA

Armchair travellers

Whether or not one believes wholeheartedly in the modern cult of amateur radio "DXpeditions"—the setting up of stations on islands from which there is little or no regular operation—there is no doubt that two-way contacts, even brief ones, with out-of-the-way places still provides an operator with a real sense of achievement, no matter how illogical this may be. Then again, compact h.f. transceivers allow holiday-makers and tourists to set up stations from hotel rooms in, for example, the smaller European countries such as Monaco, Liechtenstein, Andorra, Aland Islands and the like—and then be sure of plenty of contacts.

In Europe there are indeed very few places from which amateur operation does not take place; only Albania remains reluctant to permit either the indigenous population or tourists to use amateur radio "rigs" in that very private country.

The poor early summer this year seems to have made holiday operation more popular than ever. My own log shows that Liechenstein is proving a popular venue for German amateurs; a Dutch amateur with one of the small 10 watt transceivers has been telling me of the pleasures (and the mosquitoes) of the Northern Italian lakes while sitting on the terrace outside his holiday villa and a Greek amateur, normally located in Athens, has been praising the sunny beaches of Rhodes.

Several Finnish amateurs have crossed over to Aland Islands in the Baltic and, as usual, I have been receiving strong signals from the Royal Navy Amateur Radio Society's station on *HMS Belfast* in the Pool of London with the special callsign GB4RW to mark the Royal Wedding.

Ascension Island

The recent contact that gave me the most pleasure was with Dave, ZD8DM on Ascension Island, a thousand miles off the coast of Africa in the Southern Atlantic. A tiny island that had always previously eluded my calls, although back in 1967 I was lucky enough to make a fascinating 8000 mile trip to Ascension on what was possibly the one and only press visit in the island's history.

This was at the time of the opening of the first Cable & Wireless 42ft satellite communications terminal built on the island by the Marconi Company as part of the NASA *Apollo* network for the moon landings. Small though it is, Ascension supports more aerials to the acre than almost anywhere else on Earth.

Ascension, a tiny volcanic dot in the vast South Atlantic, has no indigenous population but it supports changing communities of Britons, Americans and contract-workers from "neighbouring" St Helena, some 800 miles away.

The island, in fact, is a remarkable mixture of the old and the new. Space and missile tracking stations (at that time it was near the end of the main American missile testing range), a large BBC overseas relay base with numbers of 250kW h.f. transmitters, a long-established Cable & Wireless telegraph cable station linking South America to Europe (and more recently on the route of the South African telephone cable) with a mass of glittering brass telegraph instruments, local medium-wave broadcasting stations and other futuristic electronics co-exist with vast colonies of wideawake terns and enormous green turtles.

While on the island I spoke over the satellite circuit to an American amateur in the NASA base in Maine—and many of the BBC and C&W staff who spend just a few years on this remote island are attracted there by the chance to operate with the rare ZD8 prefix. The American community also often includes a few radio amateurs.

Defence and H.F. Radio

It is becoming increasing clear that there has been a real revival of interest in h.f. radio communications systems among British and NATO Defence planners. According to a recent article by C. R. M. Noonan in the Marconi journal "Communication & Broadcasting", the NATO countries are currently planning to spend over £100 million on such long-established communications techniques as relatively low-speed radio-teleprinters, unprocessed analogue speech (ssb) and hand Morse.

It is recognised that this picture does not conform to the now accepted image of modern radio communications and may even seem "old hat" when compared to wideband, high-speed data and multi-channel digitally-encrypted links for speech. But h.f. is seen as having a number of special, almost unique, advantages while there is a growing belief that communications based on space satellites are vulnerable to enemy action. It is also accepted that with hand Morse operating one can continue to pass traffic in conditions which would defeat other systems.

There is also, it would appear, an increasing concern with the possible effects of the electromagnetic pulse (e.m.p.) that would follow a nuclear explosion in the upper atmosphere. It has been suggested that a single explosion, about 300 miles above the Earth's surface, could put out of action solidstate radio and electronic control equipment (including computers) over much of a continent unless more effective ways of "hardening" equipment are adopted.

For this reason we may see a revival not only of h.f. but also of miniature valves in place of the much more e.m.p.-vulnerable solidstate devices. There is some evidence that this course is already being followed in the USSR.

Television Makes News

This year's NAB and Montreaux television equipment exhibitions foreshadowed further significant developments in the field of electronic news gathering (the use of electronic rather than film cameras in news reporting). At both exhibitions were shown the first integrated colour-camera/video-recorder equipments, including a prototype unit based on a single-tube colour camera.

The "Hawkeye" unit developed jointly by RCA and Matsushita ("Panasonic") uses ½-inch tape cassettes similar in size to the VHS-format domestic VTRs and providing 20 minutes of broadcast recording time on each cassette. The single-tube Sony prototype unit is based on a new high-speed Saticon Trinicon form of pick-up tube and promises to eliminate many of the problems inherent in the accurate registration of the usual colour cameras which have three pick-up tubes; it should also reduce battery consumption which is still a problem with many of the lightweight cameras taking 25 to 35 watts.

With integrated camera/recorders, the electronic news man could be virtually as "action ready" when he arrives on the scene as the traditional film cameraman with no interconnection plugs, sockets and cables to worry about. But it may be some time yet before we see such equipment suitable for use in the European 625-line system rather than the American 525-line standard.

Trip Wires

One problem for television broadcasters that seems to be on the increase in Europe is that of aircraft flying into the high television transmitting masts or the guy wires which surround them.

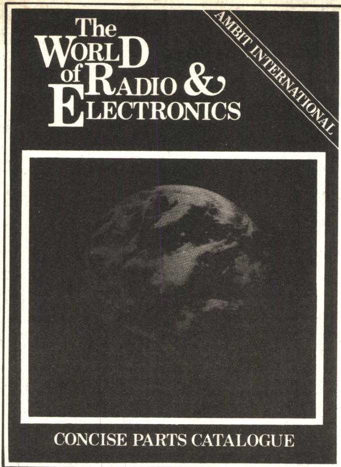
A 1000ft mast in Luxembourg was snapped in two recently with fatalities both in the plane and among the technical staff at the transmitting station when an aircraft flew into it. In the UK a light aircraft from France recently crashed with fatal consequences when it hit the guy wires of the Dover television mast.

A few years ago an American fighter aircraft hit one of the guy wires of the Caldbeck television mast in Cumbria and sliced off part of its wing. The military plane must have been very sturdily built, the pilot managed to fly it a couple of hundred miles back to its base.

Poor Horace

I suppose that in some ways it was rather sad that Horace, the BBC's sub-titling computer found it so difficult to cope "live" with the Royal Wedding commentary—but it added a touch of light relief and Horace deserves an Equity card as the year's best up-and-coming comedian.

It was a worthy try and I am sure that there must have been many hard-of-hearing viewers who benefited from the open sub-titling and who found Horace not only funny but also of tremendous help.



OUT NOW!

AMBIT'S NEW CATALOGUE

In an attempt to collate and organize our burgeoning ranges of 'stock' components (now over 7000 line items), we have at last produced a 'concise' 80 page parts catalogue to supplement the popular 'Tecknowledgey' series of 'wordy' applications catalogues, which now lists a wide range of basic components - as well as our unique RF and Communications components. The *World of Radio and Electronics* contains everything the informed electronics user needs, at prices which we guarantee will match the lowest on the market for equivalent product.

Prices appear on the page alongside the part numbers, and the catalogue is now updated quarterly - available either direct from here (60p all inc) or at most newsagents and bookstalls where you can find electronics publications. So as well as all the 'run-of-mill' items like resistor, capacitors, hardware, solder etc - you now have the first genuinely *complete* parts source for the radio, communication, electronics, computer user.

Ambit International
200, North Service Road,
Brentwood,
Essex CM14 4SG

A PROFESSIONAL TOOLCASE FOR UNDER £40

Designed for the professional Electronics, T.V or Instrument Technician who needs to carry a large number of specialist tools.

The T L 99 sets a standard as a low cost alternative to more expensive cases.
It offers strength with a practical use of space and many other features.

Features

- 2 sided Reversible Multi-purpose tool pallet
- Document area
- 90° opening lock back stays
- 3" deep ABS lid and base
- Twin handles with 8 fixing points on aluminium frames
- Burst proof toggle locks with keys
- Moulded adjustable tray in base
- Heat sink for hot soldering iron

Dimensions TL 99 17" x 12" x 6" split (shown)
also available TL100 19" x 14" x 6" split
Tools NOT included. British made.
Money back guarantee. Allow 7-21 days for delivery.

Teleman Products Ltd. Ermine House, Post St, Godmanchester, Cambs. PE 18 8BA

Order Form
Teleman Products Ltd
Ermine House, Post St, Godmanchester, Cambs. PE 18 8BA (0480) 65534
Please send .... TL99 Professional Toolcases at £39.90 each.
also available TL100 Professional Toolcases at £43.70 each.
Both inc. VAT (P&P £2.60 extra)
Enclosed my cheque for £ ....
Name ....
Company ....
Address ....
....
....

EE10

INTRODUCTION TO LOGIC

PART 6

BY J. CROWTHER

THE "AND" GATE

The AND gate is equivalent to relays (switches) in series, see Fig. 6.1.

An output will be obtained if *A* AND *B* are energised, that is if *A* AND *B* are at logic 1.

Boolean Equation

$AB=S$ for two inputs

$ABC=S$ for three inputs

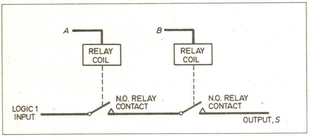


Fig. 6.1. A 2-input AND gate made up using relays.

Symbols

A number of different symbols are currently in use for representing logic gates; Fig. 6.2. shows most commonly found AND symbols. Types shown in (a) in each "symbol" diagram are those used in E.E.

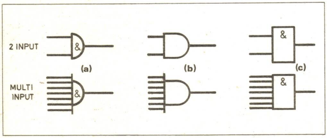


Fig. 6.2. Three different ways of representing AND gates in a circuit.

Truth Tables

In order to see at a glance what combination of inputs give an output, **Truth Tables** for a particular gate or circuit are constructed.

Truth Table for a Two Input "AND" Gate

inputs		output
A	*B*	$AB=S$
0	0	0
0	1	0
1	0	0
1	1	1

The more inputs a gate has, the more complicated the truth table becomes. For example, if a gate has ten inputs the number of possible combinations of the inputs will be 1,024. In order to be certain that none of the possible combinations have been omitted the following procedure is useful:

The number of possible combinations is given by the formula: Number of combinations $=2^n$ where n is the number of inputs.

Once the number of combinations has been established, allow this number of lines, and number them in binary, starting at 0.

example

To construct a Truth Table for a three input "AND" gate.

Since there are three inputs the number of combinations are:

$$2^3=8$$

Now draw eight rows and number them in binary, from 0 to 7 as shown.

	Inputs			Outputs
	A	*B*	*C*	$ABC=S$
0	0	0	0	0
1	0	0	1	0
2	0	1	0	0
3	0	1	1	0
4	1	0	0	0
5	1	1	0	0
6	1	1	0	0
7	1	1	1	1

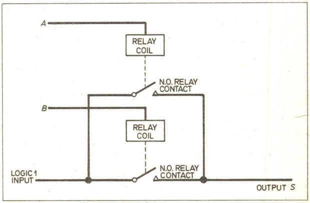


Fig. 6.3. Making up a 2-input OR gate from two relays connected in parallel.

THE "OR" GATE

The OR gate is equivalent to relays (switches), in parallel. See Fig. 6.3.

Boolean Equation

$A+B=S$ For two inputs
$A+B+C=S$ For three inputs

Symbols

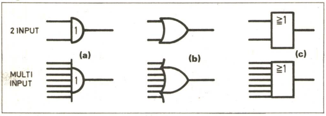


Fig. 6.4. Three different ways of representing OR gates in a circuit.

Truth Tables

Two Inputs

Inputs		Output
A	B	$A+B=S$
0	0	0
0	1	1
1	0	1
1	1	1

Three Inputs

Inputs			Output
A	B	C	$A+B+C=S$
0	0	0	0
0	0	1	1
0	1	0	1
0	1	1	1
1	0	0	1
1	0	1	1
1	1	0	1
1	1	1	1

THE "NOT" OR "INVERTER" GATE

The NOT OR INVERTER gate is the special case of one input only, and it turns logic 0 into logic 1 and vice-versa.

Therefore it turns A into $\overline{A}$, and $\overline{A}$ into A.

In other words we get an output if there is no input, so it is equivalent to a normally closed relay or switch.

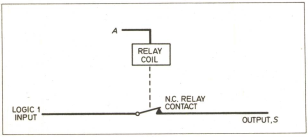


Fig. 6.5. Shows how a relay may be used to realise a NOT (or INVERT) function.

Truth Table

Inputs	Output
A	$\overline{A}=S$
0	1
1	0

Boolean Equation

$\overline{A}=S$

Symbols

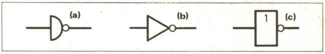


Fig. 6.6. Some symbols seen in use for representing a NOT gate in a circuit.

THE "NAND" GATE

NAND means "NOT AND", that is there is no output if AND B are both at logic 1.

Boolean Equation

Since AB means A AND B, and a bar means NOT, it follows that:

$\overline{AB}$ means NOT A AND B.

The Boolean equations for a "NAND" gate are:

$\overline{AB}=S$ for two inputs
$\overline{ABC}=S$ for three inputs

If we apply Demorgan's Theorem to $\overline{AB}$ we get $\overline{A}+\overline{B}=S$ This represents two normally closed switches or relays in parallel. Therefore a NAND gate is equivalent to Fig. 6.7.

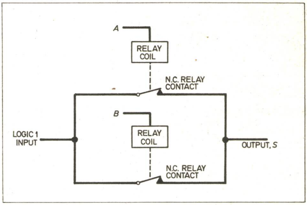


Fig. 6.7. A 2-input NAND function may be realised by using two relays (with normally closed contacts) in parallel.

Truth Tables

Two Inputs

Inputs		Output
A	B	$\overline{AB}=S$
0	0	1
0	1	1
1	0	1
1	1	0

Three Inputs

Inputs			Output
A	B	C	$\overline{ABC}=S$
0	0	0	1
0	0	1	1
0	1	0	1
0	1	1	1
1	0	0	1
1	0	1	1
1	1	0	1
1	1	1	0

By comparing the "NAND" truth table with that for the "AND" gate we will see that it is the inverse, in other words it is an "AND" gate followed by a "NOT" gate, and the symbols show this.

Symbols

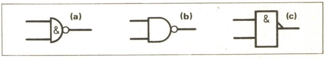


Fig. 6.8. Common symbols for representing NAND gates.

TO BE CONTINUED

CAPACITANCE METER

BY J.R.W.BARNES

It is inevitable that at some stage most constructors will be faced by an unmarked or suspect capacitor. How do you measure capacitance? Most multimeters don't have capacitance ranges, the traditional L.C.R. bridge is expensive and difficult to use. Surely a direct reading capacitance meter could be designed. As is the first step in any design, the desired specifications were chosen.

(*1*) The ability to measure most capacitors encountered in electronics excluding electrolytics.
Useful measurements can be made with the prototype of capacitors between 50pF and 1μF.

(*2*) A linear scale is very desirable.

(*3*) An accuracy of around 3 to 5 per cent can be obtained depending on the calibration standard (see later).

(*4*) The decision to make the unit mains powered was taken because, unlike a multimeter, a capacitance meter has few uses outside a workshop.

CIRCUIT

The full circuit of the Capacitance Meter is shown in Fig. 1.

To ease explanation and promote understanding the circuit can be split into four sections: pulse generator, monostable multivibrator, meter circuit and power supply.

The pulse generator is based on a unijunction relaxation oscillator. C1 charges through R10 and VR1 until the voltage across C1 equals the supply voltage multiplied by the intrinsic stand-off ratio of the unijunction, approximately equal to 7V. The capacitor is then discharged through the emitter/base 1 junction of the unijunction transistor TR1 resulting in positive pulse across R12. This turn TR2 on, reducing the voltage at pin 2 of IC1 below $^1/_3$ Vcc, and so triggering the monostable. VR1 is the calibration control; it controls the frequency with which the monostable is triggered.

TIMING RESISTOR

The widely used 555 i.c. was selected for the monostable primarily for its ability to handle wider variation of components in its timing circuit. Upon application of a trigger pulse, the unknown capacitor connected to SK1 and SK2 is charged through the timing resistor (one from R1 to R9 as selected by the range switch S1a). When the voltage across the capacitor reaches $^2/_3$ V_{CC} the capacitor is discharged. For the duration of the timing cycle the output pin 3 on IC1 goes high, this period being equal to $1{\cdot}1\ R_tC$ (where R_t is one from R1 to R9).

When the output is high D1 conducts allowing C3 to charge through R15. The voltage across C3 is indicated on the meter ME1. The deflection

COMPONENTS

Resistors

R1	10MΩ	R6	33kΩ
R2	3·3MΩ	R7	10kΩ
R3	1MΩ	R8	3·3kΩ
R4	330kΩ	R9	1kΩ
R5	100kΩ		

All ¼W metal oxide ± 2%
(e.g. Electrosil type TR5)

R10	10kΩ
R11	220Ω
R12	220Ω
R13	2·2kΩ
R14	2·2kΩ
R15	10kΩ

All ¼W carbon

See Shop Talk page 670

Potentiometer

VR1	1MΩ ⅜in square multiturn cermet trimmer

Capacitors

C1	10nF polyester, axial
C2	100nF ceramic disc
C3	100μF 16V elect., axial
C4	100μF 25V elect., axial
C5	10nF ceramic disc

Semiconductors

D1-3	1N4148 small signal silicon diode (3 off)
TR1	2N2646 unijunction transistor
TR2	2N3904 silicon *npn*
IC1	NE555 timer i.c.
IC2	μA7812 regulator 12V 1A

Miscellaneous

ME1	meter 500μA (SEW type MR65P)
SK1	insulated screw terminal, black
SK2	insulated screw terminal, red
S1	miniature Maka switch assembly and two 12-way 1-pole wafers
T1	mains transformer: 12-0-12V 100mA secondary

Stripboard 32 holes by 23 strips 0·1in matrix. Case 100 × 100 × 150mm. Miniature tag board 9 way. 6BA nuts (8 off) and bolts (4 off). Veropins. Three core mains lead. Knob, skirted with index mark. Grommet for mains lead.

Approx. cost Guidance only £16 excluding case

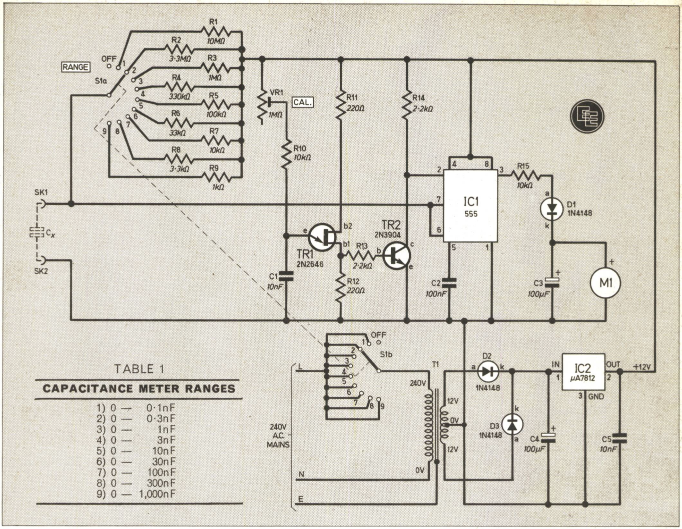


TABLE 1

CAPACITANCE METER RANGES

1) 0 —	0·1nF
2) 0 —	0·3nF
3) 0 —	1nF
4) 0 —	3nF
5) 0 —	10nF
6) 0 —	30nF
7) 0 —	100nF
8) 0 —	300nF
9) 0 —	1,000nF

Fig. 1. Circuit diagram of the Capacitance Meter.

of the meter is proportional to the value of the unknown capacitor.

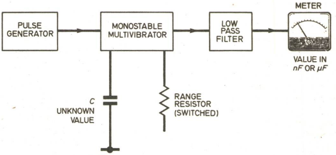
The power supply consists of T1, D2, D3 and C4 providing raw d.c. and IC2 providing a regulated 12V.

CONSTRUCTION starts here

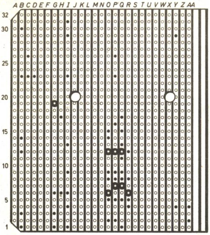
LAYOUT IMPORTANT

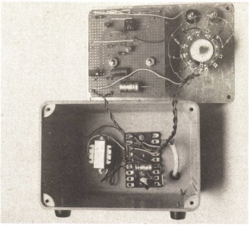
Begin construction with the stripboard; the layout given was carefully designed to minimise stray capacitance, and should be strictly adhered to. The stray capacitance shows up as residual reading of around 30pF on the lowest two ranges. This however poses no problems, it is simply subtracted from the measured reading.

HOW IT WORKS



The unknown capacitor along with the resistor selected by the range switch form the timing elements in a monostable multivibrator, the length of the output pulse being proportional to the unknown capacitor. The monostable is triggered at regular intervals by the pulse generator built around the unijunction transistor. The output of the monostable is fed to a low pass filter to produce a voltage proportional to the unknown capacitor. This voltage is displayed on the meter.





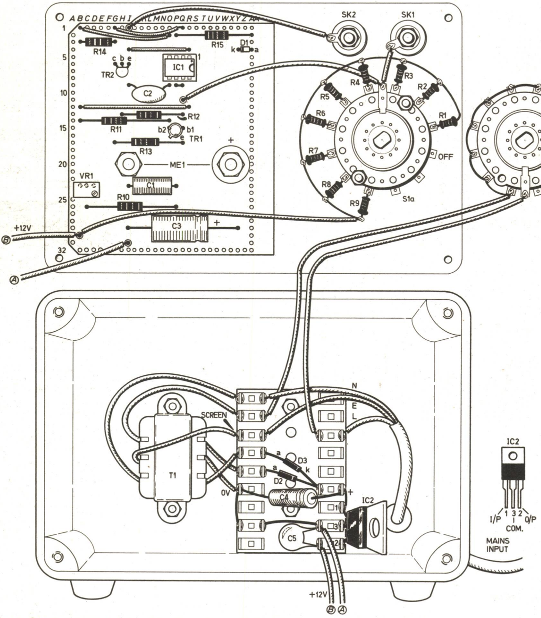


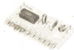
Fig. 2. Constructional details of the Capacitance Meter. The front panel has been lifted clear of the case to expose all components and wiring. At the top is an underside view of the stripboard with details of breaks in copper strips and drilling for meter terminals.

AMTRON UK LTD

ELECTRONIC KITS

KS100 MINI VHF SUPER-REGENERATIVE RECEIVER 88-108MHZ 9V D.C. **£5·34 inc VAT**

UK108 FM TRANSMITTER TUNEABLE 88-108 MHZ (NOT LICENCEABLE IN U.K.) **£10·06 inc VAT**

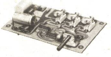

KS143 L.E.D. VU DISPLAY, INPUT 1-100W 5-12V D.C. **£9·15 inc VAT**

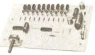
KS150 LONG PERIOD TIMER 40 SEC-90 MIN, 9-13V D.C. **£9·35 inc VAT**

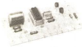
KS200 MINI F.M. TRANSMITTER 88-108 MHZ 9V D.C. (NOT LICENCEABLE IN UK) **£7·39 in VAT**

KS238 3 CHANNEL MICROPHONE OPERATED SOUND TO LIGHT, 300W PER CHAN 240V A.C. **£14·43 inc VAT**

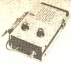
KS240 3 CHAN SOUND TO LIGHT OUTPUT 3 × 1KW 240V **£13·70 inc VAT**


KS260 3 CHAN CHASE LIGHT, 1KW PER CHAN, 240V A.C. **£11·27 inc VAT**


KS262 10 CHAN CHASE LIGHT, 300W PER CHAN, 240V A.C. **£18·72 inc VAT**


KS452 CAR LIGHT INDICATOR, AUDIO & VISUAL WARNING, ACTIVATED BY REMOVAL OF IGN KEY, 12V D.C. **£8·71 inc VAT**

UK380 DIGITAL TUNING INDICATOR LW, THROUGH TO V.H.F., VARIABLE OFFSETS, F.M. 10·6-10·7-10·8 MHZ, 262·5-460-455 KHZ, 240V A.C. **£43·47 inc VAT**


UK406 RF & AUDIO SIGNAL TRACER WITH RF PROBE **£25·62 inc VAT**

KS450 ANTI-THEFT ALARM FOR MOTORCYCLES, 6-15V D.C. **£11·88 inc VAT**

KS370 2 TONE SIREN, OUTPUT 10W @ 4 OHM, 6W @ 8 OHM, 100DBM. **£5·14 inc VAT**

UK564 LOGIC PROBE, SUITABLE FOR TTL-DTL-CMOS CIRCUITS, 5V D.C. **£9·46 inc VAT**

UK502 LW-MW 2 TRANSISTOR RADIO 6V D.C. **£7·98 in VAT**

VISA

Post & Packing, 50p per KS kit, 75p per UK kit. Send 20p S.A.E. for catalogue of our extensive range of kits & cabinets. Trade, educational & export enquiries welcomed.

7 HUGHENDEN ROAD, HASTINGS, SUSSEX. TN34 3TG
Telephone: HASTINGS (0424) 436004

Access

So you've fancied some WHARFEDALE E90 speakers –

But the bank manager won't co-operate! Don't despair – now there are Wilmslow Audio flat-pack kits for the Wharfedale E50, E70 and E90. A few hours of easy and interesting work will complete your speakers at a very considerable saving on buying 'assembled' E systems.

The kits contain all cabinet components – accurately machined for easy assembly – all drive units, crossover networks, acoustic wadding, reflex port trim, nuts, bolts, terminals, grille fabric, etc. The cabinets can be painted or stained or finished with iron-on veneer. Easy, foolproof assembly instructions are supplied — no electronic or woodworking knowledge necessary.

Prices: E50 kit **£182** per pair including VAT, carriage and insurance £ 8
E70 kit **£220** per pair including VAT, carriage and insurance £ 8
E90 kit **£330** per pair including VAT, carriage and insurance £10

Credit terms available: Deposit 20%, balance over 12 months (charges currently 26.9 APR) Through a leading Finance House. Written details on request.

WILMSLOW AUDIO
The firm for Speakers

☎ 0625 529599

35/39 Church Street, Wilmslow, Cheshire SK9 1AS

Access

Lightning service on telephoned credit card orders!

BARCLAYCARD

ELECTRONIC IGNITION SAVES PETROL

More and more new cars use electronic ignition to give the best performance and economy. Bring YOUR CAR up to top specification by fitting the latest TOTAL ENERGY DISCHARGE electronic system.

TOTAL ENERGY DISCHARGE gives all the advantages of the best capacitive discharge ignitions;

★ **Peak Performance**—higher output voltage.
★ **Improved Economy**—consistent high ignition performance.
★ **Better Starting**—full spark power even with low battery.
★ **Accurate Timing**—prevents contact wear without 'contactless' errors.
★ **Smooth Performance**—immune to contact bounce effects.

PLUS

SUPER HIGH POWER SPARK—3½ times the energy of ordinary C.D. systems.

OPTIMUM SPARK DURATION—to get the very best performance and economy with today's lean carburettor settings.

DESIGNED IN RELIABILITY—with the 'ultimate insurance' of a change-over switch to revert instantly to standard ignition.

TECHNICAL DETAILS

HIGH EFFICIENCY INVERTER. A high-power, high efficiency, regulated inverter provides a 400-volt energy source—powerful enough to store twice the energy of other designs and regulated to provide full output even with the battery down to 4 volts.

SUPERB DISCHARGE CIRCUIT. A brand new technique prevents energy being reflected back to the storage capacitor, giving 3½ times the spark energy and 3 times the spark duration of ordinary C.D. systems, generating a spark powerful enough to cause rapid ignition of even the weakest fuel mixtures without the ignition delay associated with lower power 'long burn' inductive systems. In addition this circuit maintains the correct output polarity, thereby preventing unnecessary stress on the H.T. system.

SOPHISTICATED TRIGGER CIRCUIT. This circuit removes all unwanted signals caused by contact volt drop, contact shuffle, contact bounce, and external transients which, in many designs, can cause timing errors or damaging un-timed sparks. Only at the correct and precise contact opening is a spark produced. Contact wear is almost eliminated by reducing the contact breaker current to a low level—just sufficient to keep the contacts clean.

IN MONEY-SAVING KIT FORM at £14.85
ALSO MOTORCYCLE TWIN OUTPUT KIT £22.94 Plus £1 U.K. P.&P.

All you need is a small soldering iron and a few basic tools — everything else is supplied with easy-to-follow instructions.

FITS ALL 6/12 volt NEGATIVE EARTH vehicles

Access

ELECTRONIZE DESIGN
Magnus Road, Wilnecote,
Tamworth. B77 5BY
Phone (0827) 281000

BARCLAYCARD VISA

The normal practice of cutting the board to size, drilling the large holes for the meter terminals and breaking the strips, should be followed. Then insert the Veropins, i.e. socket and wire links. The resistors and capacitors are then added. Finally the diodes and transistors can be soldered in place. Take care to ensure the diode, integrated circuit and the electrolytic capacitor are the right way round. A drawing of the stripboard is shown in Fig. 2.

The prototype used a Sew panel meter type MR65P. If a different meter is used the position of the mounting holes may need adjusting; simply move the mounting hole and the positive ends of both C3 and D1 accordingly.

Mount the range switch, two screw terminals and the meter onto the front panel.

WIRING THE SWITCH

The wiring details of the range switch are shown in Fig. 2. Care should be taken to avoid over heating the range resistors R1—R9 as this will change their values and subsequently effect the calibration.

Mount the main circuit board onto rear of meter and secure with nuts on the terminal screws.

The power supply was built on a small piece of tag board as shown in Fig. 2. Construction is straight forward, just take care to observe the polarity of the diodes and the electrolytic capacitor.

Solder the mains lead to the power supply board then feed this lead through the grommet hole at the rear of the case.

Complete all the interwiring between the range switch, test terminals, main circuit board and power supply board as shown in Fig. 2.

The tag board is mounted together with the transformer on the rear panel of the case, with 6BA nuts and bolts.

Place the front panel assembly in position and secure to the case with four screws.

FRONT PANEL

The large hole for the meter is best made by drilling a series of smaller holes and filing the resultant hole. Alternatively an "Abrafile" may be used.

CALIBRATION

In order to calibrate the instrument a "standard" capacitor is required. It is best to use a standard of either 0·01μF or 0·1μF preferably 1 per cent tolerance. Simply connect the capacitor using short leads to the terminals, select the appropriate range and adjust VR1 for full scale deflection. This single process calibrates all the ranges.

The meter scale should be linearly divided into ten, with five subdivisions between each. The main divisions should be marked 0 to 10 at the top of the scale. The bottom edge of the scale should be marked at the appropriate points "0", "0·5", "1", "1·5", "2", "2·5" and "3".

This will facilitate readings to be made on all the nine ranges. See Table 1 for range coverage. The values have been specified in nanofarads throughout, though in practise μFs would be often used, certainly for the larger values. Table 2 provides at a glance conversion from nanofarads and picofarads to microfarads.

USING THE CAPACITANCE METER

When measuring capacitors take them out of the circuit by disconnecting one lead. This is most important because any parallel components will effect the reading. It is also advisable to discharge any capacitor before measurement as any stored charge could damage the instrument.

TABLE 2

CAPACITANCE UNIT CONVERSION
Each line indicates equivalents

nanofarad (10^{-9}F)	picofarad (10^{-12}F)	microfarad (10^{-6}F)
0·1nF	100pF	0·0001μF
0·3nF	300pF	0·0003μF
1nF	1,000pF	0·001μF
3nF	3,000pF	0·003μF
10nF	10,000pF	0·01μF
30nF	30,000pF	0·03μF
100nF	100,000pF	0·1μF
300nF	300,000pF	0·3μF
1,000nF	1,000,000pF	1μF

OTHER APPLICATION—BROKEN CABLE

An ohmmeter will tell you if a cable is broken, a capacitance meter will tell you where.

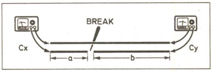


Fig. 3. Locating the break in a cable.

Measure the capacitance between the two wires or the core and the screen at both ends. The ratio of the two capacitances is also the ratio of the length from the break. In the diagram Fig. 6 $\frac{C_X}{C_Y} = \frac{a}{b}$.

JACK PLUG & FAMILY...

BY DOUG BAKER

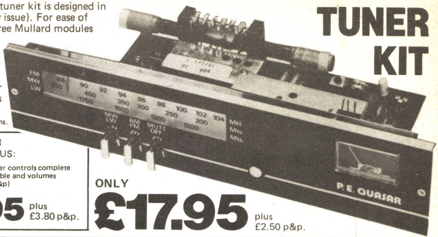
REMEMBER SAYING YOU WANTED TO FIND A HOME FOR YOUR COMPLETE COLLECTION OF EVERYDAY ELECTRONICS THAT WAS STACKED ON YOUR BENCH? WELL, I FOUND ONE FOR YOU. I GAVE THEM ALL TO A MAN COLLECTING FOR AN OLD PEOPLE'S HOME.
IF DADDY APPRECIATES ME, HE'S GOT A VERY STRANGE WAY OF SHOWING IT.

NEW

PRACTICAL ELECTRONICS - STEREO TUNER KIT

This easy to build 3 band stereo AM/FM tuner kit is designed in conjunction with Practical Electronics (July issue). For ease of construction and alignment it incorporates three Mullard modules and an I.C. IF. System.

FEATURES: VHF, MW, LW Bands, interstation muting and AFC on VHF. Tuning meter. Two back printed PCB's. Ready made chassis and scale. Aerial: AM - ferrite rod, FM - 75 or 300 ohms. Stabilised power supply with 'C' core mains transformer. All components supplied are to P.E. strict specification. Front scale size 10½"x 2½" approx. Complete with diagrams and instructions.

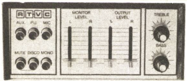


ONLY **£17.95** plus £2.50 p&p.

SPECIAL OFFER! TUNER KIT PLUS:

- Matching I.C. 10+10 Stereo Power amplifier kit (usually £3.95 + £1.15 p&p)
- Mullard LP1183 built preamp. suitable for magnetic/ceramic and auxiliary inputs (usually £1.95 + 70p p&p)
- Matching power supply kit with transformer (usually £3.00 + £1.95 p&p)
- Matching set of 4 slider controls complete with knobs for bass, treble and volumes (usually £1.70 + 80p p&p)

£21.95 plus £3.80 p&p.



STEREO AMPLIFIER KIT

- **Featuring latest SGS/ATES TDA 2006 10 watt output IC's with in-built thermal and short circuit protection.**
- **Mullard Stereo Preamplifier Module.**
- **Attractive black vinyl finish cabinet, 9"x 8¼"x 3¾" (approx)**
- **10+10 Stereo converts to a 20 watt Disco amplifier.**

To complete you just supply connecting wire and solder. Features include din input sockets for ceramic cartridge, microphone, tape or tuner. Outputs - tape, speakers and headphones. By the press of a button it transforms into a 20 watt mono disco amplifier with twin deck mixing. The kit incorporates a Mullard LP1183 pre-amp module, plus power amp assembly kit and mains power supply. Also features 4 slider level controls, rotary bass and treble controls and 6 push button switches. Silver finish fascia with matching knobs and contrasting cabinet. Instructions available, price 50p. Supplied FREE with the kit.

£14.95 Plus £2.90 p&p.

SPECIFICATIONS:	Suitable for 4 to 8 ohm speakers.
Frequency response	40Hz - 20KHz.
Input sensitivity	P.U. 150mV. Aux. 200mV. Mic. 1.5mV.
Tone controls	Bass ±12db @ 60Hz Treble ±12db @ 10KHz
Distortion	0.1% typically @ 8 watts
Mains supply	220 - 250 volts 50Hz.

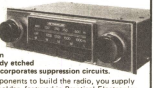
STEREO MAGNETIC PRE-AMP CONVERSION KIT
Includes FREE Magnetic cartridge with diamond styli.
All components including p.c.b. to convert your ceramic input on the 10+10 to magnetic.
Only available with 10+10 amp. **£2.00** includes p&p.

8" SPEAKER KIT Two 8" twin cone domestic speakers. **£4.75** per stereo pair plus £1.70 p&p. when purchased with amplifier. Available separately **£6.75** plus £1.70 p&p.

PRACTICAL ELECTRONICS CAR RADIO KIT

SERIES II

2 WAVE BAND MW -- LW



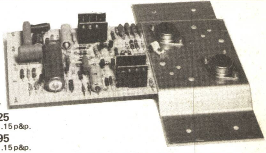
- **Easy to build**
- **5 push button tuning**
- **Modern design**
- **6 watt output**
- **Ready etched and punched PCB**
- **Incorporates suppression circuits.**

All the electronic components to build the radio, you supply only the wire and the solder, featured in Practical Electronics March issue. Features: pre-set tuning with 5 push button options, black illuminated tuning scale. The P.E. Traveller has a 6 watt output neg. ground and incorporates an integrated circuit output stage, a Mullard IF Module LP1181 ceramic filter type pre-aligned and assembled, and a Bird pre-aligned push button tuning unit.

£10.50 Plus £2.00 p&p.

Suitable stainless steel fully retractable aerial (locking) and speaker (6"x 4" app.).
available as a kit complete. **£1.95** /pack. Plus £1.15 p&p.

HIGH POWER AMPLIFIER MODULES



READY BUILT OR IN KIT FORM

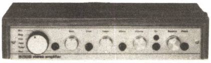
	KIT	**BUILT**
125 WATT MODEL	**£10.50** Plus £1.15 p&p	**£14.25** Plus £1.15 p&p.
200 WATT MODEL	**£14.95** Plus £1.15 p&p	**£18.95** Plus £1.15 p&p.

SPECIFICATIONS:	**125 W Model**	**200 W Model**
Max. output power (RMS)	125 watts	200 watts
Operating voltage (DC)	50 - 80 max.	70 - 95 max.
Loads	4 - 16 ohms	4 - 16 ohms
Frequency response measured @ 100 watts	25Hz - 20KHz	25Hz - 20KHz
Sensitivity for 100 watts	400mV @ 47K	40mV @ 47K
Typical T.H.D. @ 50 watts, 4 ohms	0.1%	0.1%
Dimensions (both models)	205 x 90 and 190 x 36mm.	

The P.E. power amp kit is a module for high power applications — disco units, guitar amplifiers, public address systems and even high power domestic systems. The unit is protected against short circuiting of the load and is safe in an open circuit condition. A large safety margin exists by use of generously rated components, result, a high powered rugged unit. The PC Board is back printed, etched and ready to drill for ease of construction and the aluminium chassis is preformed and ready to use. Supplied with all parts, circuit diagrams and instructions.

ACCESSORIES:

Suitable LS coupling electrolytic for 125W model	**£1.00** plus 25p p&p.
Suitable LS coupling electrolytic for 200W model	**£1.25** plus 25p p&p.
Suitable mains power supply unit for 125W model	**£7.50** plus £3.15 p&p.
Suitable Twin transformer power supply for 200W model	**£13.95** plus £4.00 p&p.



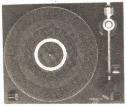
30+30 WATT STEREO AMPLIFIER

Viscount IV unit in teak simulate cabinet, silver finished rotary controls and pushbuttons with matching fascia, mains indicator and stereo jack socket. Functions switch for mic magnetic and crystal pickups, tape and auxiliary. Rear panel features fuse holder. DIN speaker and input socket 30+30 watts RMS, 60+60 watts peak. For use with 4 to 8 ohm speakers.
Size 14¾"x 10" approx.
BUILT AND TESTED.

£32.90 Plus £3.80 p&p.

PHILIPS BELT DRIVE RECORD PLAYER, DECK GC037 (Size: 15¼"x 12¼" approx.)

HiFi record player deck, 2 speed, damped cueing, auto shut-off, belt drive with floating sub chassis to minimise acoustic feedback. Complete with GP401 stereo magnetic cartridge

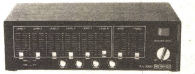


LIMITED STOCK.

UNBEATABLE OFFER AT

£27.50
COMPLETE
Plus £3.16 p&p.

MONO MIXER AMPLIFIERS



50 WATT Six individually mixed inputs for two pick ups (Cer. or Mag.), two moving coil microphones and two auxiliary for tape, tuner, organs, etc. Eight slider controls - six for level and two for master bass and treble, four extra treble controls for mic and aux inputs. Size: 13¼"x 6½"x 3¾" app. Power output 50 watts R.M.S. (continuous) for use with 4 to 8 ohm speakers. Attractive black vinyl case with matching fascia and knobs. Ready to use.

£39.95 Plus £3.70 p&p.

100 WATT

Brushed Aluminium fascia and rotary controls.
Size: approx. 14"x4"x10¼".

Five vertical slider controls, master volume, tape level, mic level, deck level, PLUS INTERDECK FADER for perfect graduated change from record deck No. 1 to No. 2, or vice versa. Pre fade level controls (PFL) lets YOU hear the next disc before fading it in.
VU meter monitors output.
100w RMS output (200w peak).

£76.00 Plus £4.60 p&p.

RTVC

CALLERS ONLY
323 Edgware Rd, London W2. Tel: 01-723 8432.
Open 9.30am - 5.30pm. Closed all day Thursday.
Persons under 16 not served without parents authorisation.
ALL PRICES INCLUDE VAT AT 15%.

MAIL ORDER ONLY
21A HIGH STREET, ACTON, W3 6NG.
Note: Goods despatched to UK-postal addresses only.
For further information send for instructions 20p plus stamped addressed envelope.

All items subject to availability. Prices correct at 1/10/80 and subject to change without notice. RTVC Limited reserve the right to update their products without notice.

ALCON

CONTINUE THEIR SPECIAL OFFER

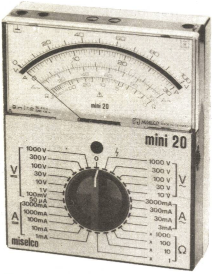
mini 20

20kΩ/V d.c. 6·6kΩ/V a.c.

multimeter

only £19.50

INCLUSIVE OF POST PACKAGE—V.A.T.



The Mini 20 is an ideal instrument for the constructor.

This special offer is a wonderful opportunity to acquire an essential piece of test gear with a saving of nearly £10 on the normal retail price.

The 26 ranges cover all likely requirements. Operation is straight-forward, just turn the selection switch to the required range.

RANGES:

d.c.V: 100mV, 1V, 10V, 30V, 100V, 300V, 1000V.
a.c.V: 10V, 30V, 100V, 300V, 1000V.
d.c.I: 50uA, 1mA, 10mA, 100mA, 1A, 3A.
a.c.I: 3mA, 30mA, 300mA, 3A.
Ohms: 0-1kΩ, 10kΩ, 100kΩ, 1MΩ.
Accuracy: 2%d.c. & resistance, 3% a.c.
Dimensions: 105 × 130 × 40mm
Movement protected by internal diode and fuse.

The instrument is supplied complete with case, leads and instructions.

For details of this and the many other exciting instruments in the Alcon range, including multimeters, component measuring and electronic instruments please write or telephone:

ALCON Instruments Ltd.

19 MULBERRY WALK · LONDON SW3 6DZ · TEL: 01-352 1897 · TELEX: 918867

Get a great deal from

Marshall's

TRANSISTORS—JUST SOME OF OUR LARGE RANGE

2N335	£1·00	2N3771	£1·65	AC187K	£0·35	BC258A	£0·12	BDY77	£1·80
2N398	£0·30	2N3772	£1·90	AC188	£0·25	BC260C	£0·15	BDY55	£1·25
2N697	£0·23	2N3789	£0·90	AC188k	£0·30	BC261/A/B	£0·22	BF160	£0·24
2N698	£0·40	2N3790	£1·50	ACY22	£0·12	BC262/B	£0·23	BF177	£0·25
2N706	£0·25	2N3791	£1·50	ACY30	£0·12	BC266A/B	£0·15	BF180	£0·35
2N706A	£0·18	2N3794	£0·12	AD161	£0·40	BC302	£0·30	BF183	£0·30
2N718	£0·27	2N3854A	£0·20	AD162	£0·40	BC307A/B	£0·10	BF195	£0·14
2N753	£0·25	2N3856A	£0·25	AF106	£0·12	BC308B	£0·10	BF196	£0·15
2N929	£0·20	2N3905	£0·14	AF109	£0·12	BC309A/ B/C	£0·10	BF197	£0·12
2N1131	£0·20	2N3962	£0·25	AF114	£0·12	BC318	£0·13	BF198	£0·17
2N1507	£0·12	2N4036	£0·48	AF126	£0·26	BC347	£0·12	BF199	£0·17
2N1637	£0·18	2N4058	£0·13	AF200	£1·00	BC350	£0·12	BF225J	£0·15
2N1638	£0·25	2N4059	£0·13	AF280	£1·00	BC384	£0·17	BF255	£0·20
2N1991	£0·35	2N4060	£0·13	BC107	£0·15	BC414	£0·14	BF257	£0·33
2N2060	£3·00	2N4249	£0·13	BC109B	£0·15	BC415	£0·14	BF338	£0·35
2N2193	£0·50	2N4284	£0·15	BC115	£0·19	BC416	£0·14	BF271	£0·20
2N2193A	£0·50	2N4286	£0·12	BC118	£0·19	BC418	£0·14	BF362	£0·40
2N2217	£0·45	2N4288	£0·12	BC135	£0·12	BC517	£0·30	BF451	£0·30
2N2221	£0·22	2N4400	£0·15	BC136	£0·12	BC547	£0·12	BFR29	£0·30
2N2221A	£0·23	2N4822	£0·50	BC140	£0·30	BC549C	£0·12	BFR81	£0·22
2N2368	£0·24	2N4898	£1·00	BC147A/B	£0·10	BC557	£0·12	BFX13	£0·42
2N2646	£0·45	2N4901	£0·50	BC149C	£0·10	BC559B	£0·12	BFX86	£0·40
2N2714	£0·12	2N4903	£1·50	BC157A/B	£0·10	BCY54	£0·50	BFY50	£0·27
2N2904	£0·28	2N4907	£1·75	BC158/B	£0·10	BCY58	£0·20	BFY51	£0·27
2N2905	£0·26	2N5033	£0·35	BC159/B	£0·11	BCY59	£0·20	BFY52	£0·23
2N2907	£0·26	2N5129	£0·12	BC160	£0·35	BCY71	£0·20	BSY51	£0·20
2N3053	£0·26	2N5220	£0·12	BC167B	£0·10	BCY72	£0·20	BSY53	£0·20
2N3054	£0·70	2N5222	£0·15	BC168B/C	£0·10	BCY78	£0·15	BSY54	£0·25
2N3055	£0·70	2N5223	£0·12	BC169B/C	£0·10	BD115	£0·25	BSY65	£0·35
2N3108	£0·30	2N5246	£0·15	BC170B	£0·10	BD116	£0·40	BSY78	£0·75
2N3393	£0·14	2N5293	£0·30	BC171B	£0·10	BD121	£0·50	ME4101	£0·12
2N3402	£0·11	2N5355	£0·13	BC172/ B/C	£0·11	BD131	£0·40	MJ430	£0·75
2N3439	£0·67	2N5448	£0·12	BC1731B	£0·11	BD138	£0·35	MJ481	£1·20
2N3440	£0·80	2N6109	£0·30	BC174B	£0·15	BD201	£1·00	MJ490	£1·20
2N3441	£0·90	2N6123	£0·53	BC182/L	£0·10	BD204	£1·20	MJE370	£0·37
2N3638	£0·15	2N6124	£0·50	BC183/L	£0·10	BD235	£0·35	TIP29A	£0·39
2N3642	£0·15	40254	£0·50	BC184	£0·10	BD240	£0·36	TIP30A	£0·47
2N3643	£0·15	40312	£0·50	BC205	£0·17	BD241	£0·50	TIP31A	£0·44
2N3702	£0·10	40316	£0·75	BC212/L	£0·10	BD242	£0·42	TIP34A	£0·85
2N3705	£0·10	40363	£0·20	BC213/L	£0·10	BD243	£0·50	TIP41A	£0·50
2N3706	£0·10	40389	£0·20	BC214/L	£0·10	BD244	£0·60	TIP54	£1·40
2N3708	£0·10	40512	£0·50	BC238	£0·10	BD433	£0·32	TIP110	£0·67
2N3709	£0·10	AC127	£0·20	BC239	£0·10	BD535	£0·45	TIP115	£0·50
2N3711	£0·10	AC128	£0·24	BC250	£0·12	BD536	£0·45	TIP117	£0·60
2N3714	£1·00	AC132	£0·21	BC251/B	£0·10	BD538	£0·44	ZTX301	£0·16
2N3716	£1·30	AC152	£0·35	BC253/C	£0·10	BD539	£0·37	ZTX303	£0·24
2N3732	£1·50	AC176K	£0·36	BC256A/B	£0·10	BD540	£0·40	ZTX501	£0·14

LINEAR INTEGRATED CIRCUITS

AY2513	£3·95	LM723CH	£0·85
CA3034	£2·50	LM723C14	£0·60
CA3049	£0·75	LM741C8	£0·20
CA3053	£0·90	LM741C14	£0·57
CA3054	£2·00	LM923	£0·44
CA3075	£2·05	LM1458N	£0·44
CA3086	£1·70	LM1801	£2·04
CA3089	£2·00	LM1871	£3·75
DP8212N	£2·05	LM1872	£3·75
INS8254N	£8·15	LM3914	£2·20
ISP8A500D	£17·50	LM3915	£2·20
LF1331N	£2·95	LM7824KC	£1·50
LF13741H	£0·40	LM78L12CZ	£0·50
LM137K	£11·52	LM78L15CZ	£0·50
LM301AH	£0·72	UA7912	£1·65
LM304H	£1·35	LM78L05CH	£0·77
LM317T	£1·50	LM78L15CH	£0·77
LM320MP5	£1·30	MC789P	£0·75
LM320MP24	£1·30	MM57160N	£5·76
LM320T12	£1·85	NE543K	£2·00
LM320T24	£1·85	NE544	£1·75
LM337K	£3·15	NE555	£0·25
LM337MP	£0·80	NE556	£0·60
LM341P5	£0·77	NE558	£3·12
LM341P2U	£0·77	NE565	£1·10
LM342P12	£0·56	NE566	£1·53
LM348	£0·90	NE570	£4·25
LM350K	£5·50	SAA5000	£3·04
LM380N14	£0·75	SAA5010	£7·11
LM381N	£1·44	SAA5012	£7·11
LM383	£1·60	SAA5020	£5·23
LM389N	£0·95	SAA5030	£8·26
LM340T5	£0·25	SAA5040	£15·14
LM716	£0·95	SAA5050	£8·51

CLOCK MODULES

MA 1002H ALARM 24 HR.	£3·50
MA 1012 ALARM 12/24 HR.	£3·50
MA 1003 12V CAR CLOCK	£12·50
MA 1026 ALARM/THERMOMETER	£11·50
CASE FOR MA 1003	£1·00

DIGITAL CIRCUITS

CD4009	£0·31	7437	£0·24
CD4013B	£0·33	7440	£0·14
CD4015	£0·62	7441AN	£0·60
CD4022B	£0·65	7442	£0·45
CD4027B	£0·37	7445	£0·72
CD4028B	£0·57	7446AN	£0·45
CD4030B	£0·45	7447AN	£0·45
CD4042B	£0·55	7448N	£0·45
CD4043	£0·61	7453	£0·45
CD4044	£0·62	7454	£0·15
CD4045	£1·30	7460	£0·15
CD4046B	£0·74	7470	£0·30
CD4048B	£0·43	7472	£0·28
CD4051B	£0·60	7473	£0·28
CD4052B	£0·60	7474	£0·28
CD4063	£0·94	7475	£0·29
CD4066B	£0·35	7476	£0·30
CD4068	£0·20	7483	£0·60
CD4077	£0·23	7484	£0·95
CD4093B	£0·42	7485	£0·75
CD4094	£1·66	7486	£0·25
CD4098B	£0·85	7489	£2·00
CD4099B	£0·30	7490AN	£0·28
CD4503	£0·47	7491AN	£0·60
CD4510B	£0·65	7493N	£0·30
CD4515	£1·95	7495	£0·58
CD4516	£0·70	7496	£0·34
CD4522	£1·10	7497	£1·74
7404	£0·10	74107	£0·28
7406	£0·33	74118	£0·84
7407	£0·27	74119	£1·25
7411	£0·22	74121N	£0·25
7412	£0·18	74122N	£0·50
7413	£0·28	74123N	£0·45
7416	£0·25	74125	£0·44
7417	£0·25	74141	£0·45
7420	£0·16	74148	£0·95
7423	£0·25	74150	£0·95
7425	£0·25	74151	£0·54
7426	£0·29	74154	£0·95
7427	£0·29	74155	£0·60
7432	£0·24	74157	£0·59
		74163AN	£0·87
		74164N	£0·85
		74165N	£0·85
		74174N	£0·77
		74175N	£0·60
		74182N	£0·80
		74190N	£0·85
		74197N	£0·70

PRESENSITISED POSITIVE FOTO RESIST PC

BOARDS 1·6mm THICK

SIZE	*SINGLE SIDE*	*DOUBLE SIDE*
100 × 150mm	£1·40	£1·65
100 × 220mm	£1·95	£2·05
203 × 114mm	£1·70	£2·10
233·4 × 220mm	£3·75	£4·50

SENSORS FOR DIGITAL FUEL STRETCHERS

FUEL FLOW	£14·95	SEND LARGE S.A.E. FOR DETAILS
SPEED	£11·95	

SEND 75p
FOR OUR LATEST
LIST POST PAID

A. Marshall (London) Ltd.,
Kingsgate House, Kingsgate Place, London NW6 4TA
Industrial Sales: 01-328 1009 Mail Order: 01-624 8582 24hr service
Also retail shops: 325 Edgware Road, London W2,
85 West Regent Street, Glasgow

PLEASE ADD POSTAGE/PACKING 60p UNLESS STATED,
ALSO 15% VAT ON TOTAL
ABOVE PRICES ARE MAIL ORDER ONLY

SQUARE one FOR BEGINNERS

This regular feature provides an easy guide to circuit components and materials and the techniques involved in building electronic projects.

THIS month we look at resistors. These are the most commonplace of components.

Resistors fall into the following classes:
(*a*) fixed value
(*b*) variable (potentiometers).

FIXED VALUE RESISTORS

Some fixed value resistors are **wire wound.** These are only used for certain special applications.

The most frequently used fixed value resistors are small tubular components with lead out wires emerging from either end. There are four principal types: **carbon composition, carbon film, metal film** and **metal oxide.** All of these are available in a very wide range of resistance values —expressed in ohms (Ω)—from 10 ohm to 1 megohm and even higher.

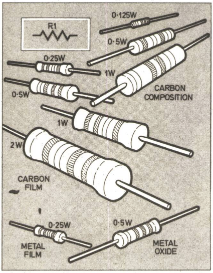


Fig. 1. Fixed value resistors. Shown here are carbon composition, carbon film and metal oxide resistors of typical wattage ratings. All are drawn to scale and are actual size. The circuit symbol for a fixed value resistor is also shown.

The generally available "preferred" values are 10, 12, 15, 18, 22, 27, 33, 39, 47, 56, 68, 82 ohms, and decadal multiples of these.

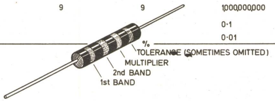
For example: **10,** 100, 1,000, 10,000, 100,000, 1,000,000 ohms.

39, 390, 3,900, 39,000, 390,000, 3,900,000 ohms. These are expressed in more practical terms as 39Ω, 390Ω, 3·9kΩ, 39kΩ, 390kΩ, 3·9MΩ.

It will be seen that k (kilo) means 10^3 and M (mega) means 10^6.

RESISTOR COLOUR CODE

Band (ring) Colour	BAND 1 (1st Figure)	 2 (2nd Figure)	 3 (Multiplier)	 4 (Tolerance %)
BLACK	0	0	–	–
BROWN	1	1	10	1
RED	2	2	100	2
ORANGE	3	3	1,000	3
YELLOW	4	4	10,000	4
GREEN	5	5	100,000	–
BLUE	6	6	1,000,000	–
VIOLET	7	7	10,000,000	–
GREY	8	8	100,000,000	–
WHITE	9	9	1,000,000,000	–
GOLD			0·1	5
SILVER			0·01	10



Examples:

① BAND	COLOUR		
1	RED	2	
2	VIOLET	7	
3	YELLOW	x10,000	=270,000 OHMS OR 270kΩ
4	GOLD	±5%	±5% TOLERANCE

② BAND	COLOUR	
1	ORANGE	
2	ORANGE	
3	RED	= 3·3kΩ
ABSENCE OF BAND 4		=±20% TOLERANCE

COLOUR CODE

The resistance value is indicated by coloured bands on the body of the resistor. This colour code is explained in the illustration.

It is an excellent idea for beginners to obtain an assortment of resistors and practise working out the code.

WATTAGE

The physical size of these fixed value resistors determines the power they can safely carry, without over heating with possible degradation of rated ohmic value. Power (volts× amps) is expressed in watts (W).

The forementioned values are available in the following wattage ratings.
Carbon composition: 0·125W, 0·5W, 1W
Carbon film: 0·25W, 0·5W, 1W, 2W
Metal film: 0·25W
Metal Oxide: 0·5W

EAGER TO START?

If you are handy with a lightweight soldering iron, try one of our Popular Designs. Read the notes on page 682.

How to Solder will be the subject of next month's Square One.

LETTERS

Good Choice

I have just received my May edition of EVERYDAY ELECTRONICS and have read the article concerning the introduction of 27MHz CB to England with great interest *(and amazement)*.

It is not my intention to argue the pros and cons for the introduction of CB—that is a domestic problem for your country and government however—I am surprised at the reasons quoted for choosing F.M. instead of A.M. viz, the interference caused to TV, radio and hi-fi. I thought this would be a reflection on the "quality" of the radio, TV and hi-fi equipment.

In my experience, the greatest majority of hi-fi problems are the result of inadequate RF by-passing in the hi-fi unit, television receivers with open antennas (e.g. rabbit ears) and front ends which lack selectivity, likewise radios which lack selectivity.

The nature of interference to other services is not mentioned so I will not comment further on that aspect.

The New Zealand Post Office Engineers Department, whose job it is to check on interference as reported to them, issue several pamphlets outlining these problems and state clearly that in most cases the fault lies in the hi-fi, radio and TV equipment and not in the transmitting equipment and suggest persons experiencing these problems contact the manufacturer/manufacturers agents who are generally helpful. I think the theory is something like "it is cheaper to cure on a one-off basis than build it into all equipment during manufacture". However, with increased population densities in the UK than in NZ this may not hold true.

It would appear that of the 5,000 complaints the British authorities received as the result of CB equipment reflect not 5,000, nor half that number, faulty CB rigs, but a figure approaching 5,000 faulty or poorly designed hi-fi, TV and radio units.

Regardless of my critisism on this technical aspect, I feel sure that the choice to use frequency modulation is a good choice and that users of such mode will be pleasantly surprised how much superior it really is to A.M., especially in the mobile situation or a base station situation located on a main traffic route.

Furthermore, as a licenced amateur, I cannot support the illegal useage of radio transmitting apparatus or radio spectrum by any party.

I look forward to the comments of other readers and perhaps also the technical staff at EVERYDAY ELECTRONICS.

Peter Jones 2L1BVJ,
Mt. Roskill, Auckland N.Z.

Control Wanted

Has any reader a "Proops Drill-Speed Controller" for which they have no further use? I am prepared to pay full price plus any postal charges. I have contacted Proop Brothers who no longer manufacture this controller.

If not, can any reader supply the circuit for same as I have all the parts to rebuild my old one which I burnt out.

I am a regular reader of "Everyday Electronics" and really enjoy every part of it—carry on the good work.

C. F. Hartley,
Willington, Crook,
Co. Durham.

Most Fortunate

While I am writing, I would like to thank you for your excellent magazine and add my voice to those in the "Keep it on Stripboard" lobby. When I first bought your magazine, in August 1980, I had absolutely no knowledge of things electronic. I had bought one or two other electronic magazines and found that I could not make head nor tail of them.

I then decided that I would buy one last electronics magazine, and, if I could not make sense of it, I would give up and see if bird-watching was at all interesting!

Fortunately I bought EVERYDAY ELECTRONICS, and, although I did not understand much, I saw that there would probably be something for me in your series *I.C.s Explained* which turned out to be excellent.

Now I spend any money which I have on components and my desk is in an eternal mess—but thanks—I enjoy it!

I feel that, while being excellent for experienced constructors, EVERYDAY ELECTRONICS is too good a beginners' magazine to drive beginners away by putting circuits on p.c.b., which they (change that to "we"!) will not wish to make.

Alan Potter (age 15),
Mount Vernon, Glasgow

Most Worried

I was most worried a few days ago when I acquired my July copy of EVERYDAY ELECTRONICS because of the realisation that all but one of the projects featured used a printed circuit board (p.c.b.).

I hope this is not a trend which will feature in further issues of EE for I prefer to use Veroboard than to laboriously draw and etch a p.c.b.

R. S. Lewis,
Port Talbot, Glamorgan

It was quite by chance that the July issue contained four projects using printed circuit boards.

We can assure you that this is not the commencement of a change of policy to switch over to p.c.b.s. We shall continue, in general, to publish the majority of projects using stripboard.—Ed.

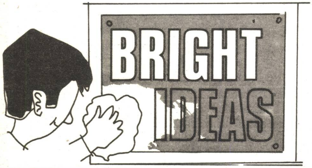
Beginner in Bristol

As a beginner in electronics, I am not sure of the different values of capacitors. Perhaps you could include an article on capacitor values in *Square One.*

Robert Preddy (age 13),
Bristol

You did not give your full address Robert, so we hope you see this. In our most recent issues, capacitors were dealt with through the Square One pages. These featured non-polarised, polarised and variable capacitors.

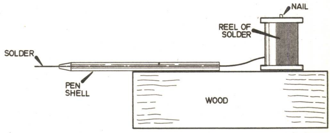
Write again with your complete address and I will send copies of some other previous Square One pages that dealt with capacitor values.—Ed.



Readers' Bright Ideas; any idea that is published will be awarded payment according to its merit. The ideas have not been proved by us.

SOLDER HOLDER

It seems to me that when soldering you need three pairs of hands—one to hold the solder, one to hold the board and component, and one to hold the soldering iron.

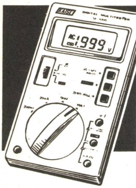


I have devised a holder for the solder. You will need an old ball pen tube and a block of wood. First glue the tube to the wood as shown in the diagram then thread your solder through the tube leaving about 25mm showing at the end. A thin nail will hold the solder reel in position. It is now ready for use.

David Hall,
Selby,
Yorkshire

LCD DIGITAL MULTIMETERS

ALL PRICES INCLUDE VAT



WHILE STOCKS LAST!

MODEL 6110

3½ Digit LCD featuring 23 ranges with volts/ohms autorange, unit and sign indicators, 10 amp AC/DC, battery warning, low power ohms ranges. Range hold and continuity buzzer. Fuse protected. Resolution 0.1mV DC, 1mV AC, 10 microamp, 0.1ohms. Supplied with battery and leads.
Fitted top quality rotary switch.

Was £85.95 as advertised by us
Now £59.95 post paid.
plus free carry case.

- **LIMITED OFFERS WHILST STOCKS LAST**
- **ORDER BY POST OR PHONE IN WITH BARCLAY - VISA - ACCESS - TRUST CARDS.**

RANGES

AC/DC Current - 20mA/200mA/10 amp.
DC Voltage (auto) - 200mV/2V/20V/200V/1000V.
AC Voltage - 2V/20V/200V/600V.
Resistance (auto) - 200/2K/20K/200K/2000K ohm.

ALSO AVAILABLE MODEL 6220
As 6110 but without range hold and continuity buzzer. Only two AC/DC 200mA/10 amp ranges i.e. 22 ranges. Was £55.95. Now **£42.95** post paid.

AUDIO ELECTRONICS Cubegate Limited
OPEN SIX DAYS A WEEK • CALL IN AND SEE FOR YOURSELF
301 EDGWARE ROAD, LONDON, W2 1BN, ENGLAND. TEL 01-724 3564
ALSO AT HENRYS RADIO, 404/406 EDGWARE ROAD, LONDON W2

BARCLAYCARD VISA
AMERICAN EXPRESS

TEACH-IN '82

STARTS THIS MONTH!!

Full set of parts as specified by "EE". All new goods, despatched by return of post.

★ All parts for the "MINILAB" only **£17·50** + £1 post

★ All components for first 6 parts of "TEACH-IN '82" **£7·50** + 60p post.

BUY BOTH SETS FOR **£24** + £1 post !!
Deduct £1 if Vero voucher enclosed

FREE catalogue with all orders ! !

FREE component Identification Chart ! !

FREE piece of Veroboard ! !

Send NOW to: **(All prices inc. VAT)**

GREENWELD

443D Millbrook Road, Southampton, SO1 0HX
Tel (0703) 772501

ELECTRONI·KIT

DENSHI KITS—

Final offer on kit type SR-3A

" . . . . fun and entertainment as well as education" —
(EVERYDAY ELECTRONICS mag.)

This is the final opportunity to obtain this first-class multi-project kit at little more than its 1977 price! **(Current value over £40).**

Circuits are constructed by plugging the encapsulated components into the boards provided, following the instruction manual. Technical details are also given concerning each project. The components are used over and over again and you can design your own circuits too, or use the kit as a useful testing board. No previous experience of electronics is required but you learn as you build—and have a lot of fun too. The kits are **safe for anyone.**

SR-3A KIT (16½″ 10″ 2½″) **£29·95**

Build over 100 projects including 3-TR reflex radio receiver, 3-TR radio receiver with RF amplifier, 2-TR reflex radio receiver, 3-TR amplifier for crystal mike, 3-TR amplifier for speaker/mike, 3-TR signal tracer, Morse Code trainer, 2-TR electronic organ, electronic metronome, electronic bird, electronic cat, electronic siren, electronic gun, 2-TR sleeping aid, high voltage generator, discontinuity warning device, water supply warning device, photoelectric alarming device, 3-TR burglar alarm, 3-TR water supply warning device, 3-TR water level warning device, 3-TR photoelectric alarming device, Morse Code trainer with sound & light, discontinuity warning device with sound & light, water level warning device with sound & light, electronic metronome with sound & light, buzzer with sound & light, wireless mike, wireless telegraph set, wireless discontinuity warning device, wireless water level warning device, wireless water supply warning device, wireless photoelectric warning device, etc.

All kits are guaranteed and supplied complete with extensive construction manual **PLUS** Hamlyn's "All Colour" 160 page book "Electronics" (free of charge whilst stocks last).

Prices include educational manual, free book, VAT, p & p (in the UK), free introduction to the British Amateur Electronics Club.

PLEASE NOTE OUR NEW ADDRESS.
PERSONAL CALLERS WELCOME.

Cheque/P.O./Access/Barclaycard (or 23p for illustrated literature) to **ELECTRONI-KIT LTD., Dept. EE.**

ELECTRONI-KIT LTD.
388 ST. JOHN STREET
LONDON, EC1V 4NN (01-278 0109)

E.E. PROJECT KITS

Make us your No. 1 SUPPLIER OF KITS and COMPONENTS for E.E. Projects. We supply carefully selected sets of parts to enable you to construct E.E. projects. Kits include ALL THE ELECTRONICS AND HARDWARE NEEDED. Printed circuit boards (fully etched, drilled and roller tinned) or veroboard are, of course, included as specified in the original article, we even include nuts, screws and I.C. sockets. PRICES INCLUDE CASES unless otherwise stated. BATTERIES ARE NOT INCLUDED. COMPONENT SHEET INCLUDED. If you do not have the issue of E.E. which includes the project—you will need to order the Instruction reprint at an extra 45p each.

Reprints available separately 45p each + p. & p. 40p.

LED SANDGLASS. Aug. 81	£7·98
WHEEL OF FORTUNE. Aug. 81. less wire, panel and case	£43·98
CMOS METRONOME. Aug. 81	£7·70
DOOR ALARM. Aug. 81.	£11·98
WEATHER CENTRE. Aug. 80 less case	£44·26
COMBINATION LOCK. July 81 Less case	£18·30
BURGLAR ALARM SYSTEM. June 81 Less bell, loop switches, & microphones	£38·30
TAPE AUTO START. June 81	£11·96
TREMELO. June 81 Less case	£10·46
LOOP AERIAL CRYSTAL SET. June 81	£5·47
LIGHTS REMINDER AND IGNITION LOCATOR E.E. May 81	£5·29
SOIL MOISTURE INDICATOR E.E. May 81	£3·83
T. V. INTERFERENCE FILTERS E.E. May 81. LOW PASS less tin-plate **£2·88.** HIGH PASS **£1·56**	
GUITAR HEADPHONE AMPLIFIER E.E. May 81.	£3·96
PHONE BELL REPEATER/BABY ALARM E.E. May 81	£5·29
Rectangular cases.	
AUDIO TEST SET E.E. May 81. **£44·92**	Less case. Case extra £6·95
DIGITAL RULE (ultrasonic) April 81	£30·20
INTERCOM April 81	£20·76
FREEZER ALARM April 81	£12·43
SIMPLE TRANSISTOR & DIODE TESTERS. Mar. 81 Ohmeter version **£1·89** Led version	£2·56
MINI SIREN. Mar. 81	£7·52
LED DICE. Mar. 81.	£7·89
LED FLASHER. Mar. 81	£4·01
MODULATED TONE DOORBELL. Mar. 81	£6·21
BENCH POWER SUPPLY. Mar. 81	£49·98
TREBLE BOOST. Mar. 81.	£6·84
CAR ACTUATED DRIVEWAY LIGHT. Feb. 81 less socket	£23·90
THREE CHANNEL STEREO MIXER. Feb. 81	£17·47
SIGNAL TRACER. Feb. 81	£7·64 less probe
FOUR BAND RADIO. Feb. 81	£39·98
Ni-Cd BATTERY CHARGER. Feb. 81	£12·72
ULTRASONIC INTRUDER DETECTOR. Jan. 81 less case	£49·98
AUTO SLIDE CHANGER. Jan. 81	£9·28
PHASER SOUND EFFECTS. Jan. 81	£25·11
LOGIC PULSE GENERATOR. Jan. 81	£7·48
2 NOTE DOOR CHIME. Dec. 80	£9·65
LIVE WIRE GAME. Dec. 80	£10·94
SOUND TO LIGHT. Nov. 80. 3 channel	£19·95
GUITAR PRACTICE AMPLIFIER. Nov. 80	£11·99 less case
Standard case **£3·88.** High quality case **£8·33.**	
SOIL MOISTURE MONITOR. Nov. 80	£5·43 inc. probes
TRANSISTOR TESTER. Nov. 80	£10·87 inc. test leads
AUDIO EFFECTS UNIT FOR WEIRD SOUNDS. Oct. 80	£12·26
PHONE CALL CHARGE JOGGER. Oct. 80	£6·80
BICYCLE ALARM. Oct. 80	£9·68 less mounting brackets
IRON HEAT CONTROL. Oct. 80	£5·48
DARKROOM CONTROLLER. Oct. 80	£23·81 case differs
BEDSIDE RADIO. Sept. 80	£17·57
TTL LOGIC PROBE. Sept. 80	£4·85
TTL POWER SUPPLY UNIT. Sept. 80	£15·09
CRICKET GAME. Aug. 80	£19·16
WEATHER CENTRE. Aug. 80 (less case)	£44·26
AUDIO MILLIVOLTMETER. Aug. 80	£19·64
AUTOPHASE. June 80. Rectangular Case	£23·55
COURTESY LIGHT DELAY. June 80	£6·69
A.F. SIGNAL GENERATOR. June 80	£24·79
AUTOWAA. June 80. Rectangular Case	£23·46
G.P. AMPLIFIER. June 80	£7·26
SIGNAL TRACER. June 80	£5·98
ZENER DIODE TESTER. June 80	£6·23

ADVENTURES WITH MICROELECTRONICS

by Tom Duncan

An easy to follow book suitable for all ages. Ideal for beginners. No soldering. Uses a Bimboard 1 breadboard, gives clear instructions with lots of pictures. 11 projects based on integrated circuits—includes dice, two-tone doorbell, electronic organ, MW/LW radio, reaction timer, etc. Component pack includes a Bimboard 1 breadboard and all the components for the projects.

Adventures with Microelectronics **£2·55**. Component pack **£29·64** less battery.

ADVENTURES WITH ELECTRONICS

by Tom Duncan

An easy to follow book suitable for all ages. Ideal for beginners. No soldering, uses an S-Dec breadboard. Gives clear instructions with lots of pictures. 16 projects—including three radios, siren, metronome, organ, intercom, timer, etc. Helps you learn about electronic components and how circuits work. Component pack includes an S-Dec breadboard and all the components for the projects.

Adventures with Electronics **£2·40**. Component pack **£17·98** less battery.

MAGENTA EL

4 STATION RADIO. May 80	£15·33 less case
AUTOFADE. May 80	£10·95
LIGHTS WARNING SYSTEM. May 80	£4·38
BATTERY VOLTAGE MONITOR. May 80	£4·63
AUDIO TONE GENERATOR. May 80	£3·88
GAS SENTINEL. April 80	£28·95
AUTO LEVEL CONTROL. April 80	£8·45
CABLE & PIPE LOCATOR. Mar. 80	£3·85 less coil former
KITCHEN TIMER. Mar. 80	£13·70
STEREO HEADPHONE AMPLIFIER. Mar. 80	£16·97
5 RANGE CURRENT LIMITER. Mar. 80	£4·66
MICRO MUSIC BOX. Feb. 80 **£15·20**	Grey Case £3·99 extra.
SIMPLE SHORT WAVE RECEIVER. Feb. 80	£24·17
Headphones **£2·98.**	
SLIDE/TAPE SYNCHRONISER. Feb. 80	£11·50
MORSE PRACTICE OSCILLATOR. Feb. 80	£4·32
SPRING LINE REVERB. UNIT. Jan. 80	£24·17
UNIBOARD BURGLAR ALARM. Dec. 79	£5·64
BABY ALARM. Nov. 79	£8·98
OPTO ALARM. Nov. 79	£6·34 inc. optional ports
MW/LW RADIO TUNER. Nov. 79	£16·99 less dial
ONE ARMED BANDIT. Oct. 79	£24·60
HIGH IMPEDANCE VOLTMETER. Oct. 79	£17·45
CHASER LIGHTS. Sept. 79	£21·97
VARICAP M.W. RADIO. Sept. 79	£9·87
SIMPLE TRANSISTOR TESTER. Sept. 79	£6·88
ELECTRONIC TUNING FORK. Aug. 79	£9·99
Suitable microphone & plug **£1·79** extra.	
WARBLING TIMER. Aug. 79	£6·87
9V POWER SUPPLY. Aug. 79	£10·93 inc. pcb
SWANEE WHISTLER. Aug. 79	£3·50
DARKROOM TIMER. July 79	£2·71
TREMOLO UNIT. June 79	£12·38
ELECTRONIC CANARY. June 79	£5·48
LOW COST METAL LOCATOR. June 79	£5·98
Handle & coil former parts extra **£6·10.**	
QUAD SIMULATOR. June 79	£6·87
INTRUDER ALARM. May 1979	£18·38
Less Ext. Buzzer & Lamp and Loop Components.	
THERMOSTAT. 'PHOTO' SOLUTIONS. May 79.	£17·62
Less socket, tube and grease.	
TRANSISTOR TESTER. April 79	£4·55
TOUCH BLEEPER. April 79	£3·87
ONE TRANSISTOR RADIO. Mar. 79. Less case	£7·62
MICROCHIME DOORBELL. Feb. 79	£14·82
AUDIO MODULATOR. Feb. 79	£1·71 less case and pins
THYRISTOR TESTER. Feb. 79	£3·54
ADJUSTABLE PSU. Feb. 79	£31·87
HEADPHONE ENHANCER. Jan. 79	£2·86
FUZZ BOX. Dec. 78	£6·82
MIC. AMP. Dec. 78	£3·08
AUDIBLE FLASHER. Dec. 78	£1·33
VEHICLE IMMOBILISER. Inc. PCB. Dec. 78	£6·31
AUDIO EFFECTS OSCILLATOR. Nov. 78	£4·38 inc. board
PASSIVE MIXER. Oct. 78	£4·09
FUSE CHECKER. Oct. 78	£2·16
TREASURE HUNTER. Oct. 78	£19·64 less handle & coil former
GUITAR TONE BOOSTER. Sept. 78	£5·48 in. p.c.b.
SOUND TO LIGHT. Sept. 78	£7·67
FILTER	£1·82
CAR BATTERY STATE INDICATOR. Sept. 78. Less case	£1·96
R.F. SIGNAL GENERATOR. Sept. 78	£24·98
SLAVE FLASH. Aug. 78	£3·52 less SK1
LOGIC PROBE. July 78	£2·78
IN SITU TRANSISTOR TESTER. June 78	£6·33
FLASHMETER. May 78	£14·12 less calc and diffuser
POCKET TIMER. April 78	£3·27
WEIRD SOUND EFFECTS GENERATOR. Mar. 78	£5·28
CHASER LIGHT DISPLAY. Feb. 78	£31·68
AUDIO VISUAL METRONOME. Jan. 78	£5·63
ELECTRONIC TOUCH SWITCH. Jan. 78	£2·56 less case
RAPID DIODE CHECK. Jan. 78	£2·57
AUTOMATIC PHASE BOX. Dec. 77	£11·50 inc. p.c.b.
VHF RADIO. Nov. 77	£15·79
ULTRASONIC REMOTE CONTROL. Nov./Dec. 77	£17·69
ADD-ON CAPACITANCE UNIT. Sept. 77	£6·58
PHONE/DOORBELL REPEATER. July 77	£6·98
ELECTRONIC DICE. March 77	£5·31

1981 ELECTRONICS CATALOGUE

KITS
I.C.s
TRANSISTORS
CAPACITORS

Hundreds of illustrations, product data, circuits, and details of all our kits and educational courses.
Up to date price list included. All products are stock lines for fast delivery. Send 70p in stamps or add 70p to order.

TOOLS
RESISTORS
HARDWARE
CASES

MAGENTA gives you **FAST DELIVERY OF QUALITY COMPONENTS & KITS.** All products are stock lines and are new & full specification. We give personal service & quality products to all our customers—**HAVE YOU TRIED US?**

MAGENTA ELECTRONICS LTD.

EN32, 135 HUNTER ST. BURTON-ON-TRENT, STAFFS.,
DE14 2ST. 0283 65435. MON.-FRI. 9-4. MAIL ORDER ONLY.
ADD 40p P. & P. TO ALL ORDERS.
ALL PRICES INCLUDE 15% V.A.T.

Buy it with Access

BARCLAYCARD welcome here

OFFICIAL ORDERS WELCOME.
IRISH REPUBLIC & B.F.P.O. EUROPE: Deduct 10% from prices shown Payment. must be in Sterling.
ACCESS and BARCLAYCARD (VISA) ORDERS ACCEPTED BY PHONE OR POST.

ECTRONICS LTD.

TEACH IN 82

NEW SERIES—ALL COMPONENTS IN STOCK NOW FOR FAST DELIVERY. All top quality components as specified by Everyday Electronics. Our kit comes complete with **FREE COMPONENT IDENTIFICATION SHEET.** Follow this educational series and learn about electronics—Start today.

Send £24·98 for List 1 2. 'VERO/E.E. £1·00 vouchers accepted. **WOODEN CASE KIT** also available. Phone or send SAE for price and details.

IDEAL SOLDERING EQUIPMENT FOR THE TEACH IN AND ELECTRONICS

ANTEX X5 SOLDERING IRON 25W **£5·48**
SOLDERING IRON STAND **£2·40**
SPARE BITS. Small, standard, large. **65p** each. For XS+X25.
SOLDER. Handy size **99p.**
HOW TO SOLDER LEAFLET **12p**
DESOLDER BRAID **69p.**
HEAT SINK TWEEZERS **29p**
DESOLDER PUMP **£6·48**
SOLDER CARTON **£1·84**
LOW COST CUTTERS **£1·69**
LOW COST LONG NOSE PLIERS **£1·68**
WIRE STRIPPERS & CUTTERS **£2·69**

EE KITS SEPT '81

MODEL RAILWAY SPEED CONTROLLER, Sept. 81	**£13·46**
0-12V POWER SUPPLY, Sept. 81	**£16·84**
ANTI THEFT LINK DEVICE, Sept. 81	**£7·99**
CMOS CAR SECURITY ALARM, Sept. 81	**£8·49**
AUDIO COMPRESSOR MIXER, Sept. 81	**£21·21**
CMOS DIE, Sept. 81	**£7·47**

C106D	**56p**	2N5457	**58p**	BFY51	**24p**
TIC46	**49p**	2N5484	**63p**	BFY52	**23p**
OA47	**11p**	40673	**98p**	BFX88	**32p**
OA90	**9p**	AC128	**29p**	BRY39	**48p**
OA202	**16p**	AC141	**38p**	MPSA65	**39p**
WO05	**33p**	AC142	**39p**	RPY58A	**£1·16**
W06	**47p**	AC176	**37p**	TIP31A	**52p**
Z5J	**£2·92**	BC182	**11p**	TIP32A	**83p**
IN4001	**5½p**	BC182L	**11p**	TIP33A	**94p**
IN4005	**6p**	BC183	**11p**	TIP34A	**99p**
IN4148	**5p**	BC184	**11p**	TIP121	**£1·12**
IN5404	**18p**	BC184L	**11p**	TIP2955	**69p**
IN5408	**19p**	BC212	**11p**	TIP3055	**69p**
BF244B	**87p**	BC212L	**11p**	TIS43	**38p**
MPF102	**69p**	BC213	**11p**	TPSA13	**35p**
TIS88A	**57p**	BC214	**11p**	2N3053	**25p**
VN67AF	**£1·21**	BC214L	**11p**	2N3055	**59p**
2N3819	**28p**	BD131	**48p**	2N3702	**11p**
2N3820	**78p**	BFY50	**25p**	2N3704	**11p**

LINEAR I.C.s			
		LM2917N	**£2·27**
555	**32p**	LM3900W	**85p**
556	**79p**	LM3909N	**79p**
741	**28p**	LM3911N	**£1·55**
748	**55p**	LM3914N	**£2·89**
CA3080	**£1·21**	LM3915N	**£2·98**
CA3085A	**£1·32**	MC3340	**£2·15**
CA3130T	**£1·12**	TBA820	**£1·05**
CA3140E	**57p**	TL064	**£2·59**
HA1388	**£2·85**	U237B	**£1·69**
ICL7611	**£1·04**	ULN2283B	**£1·47**
ICL8038CC	**£3·92**	ZN1034E	**£3·19**
ICM7555	**£1·19**	ZN414	**£1·09**
LF351	**58p**	ZN419CE	**£2·59**
LF353	**96p**	ZN424E	**£2·14**
LF356	**99p**	ZN425E	**£5·98**
LM301AN	**39p**	**CMOS**	
LM309K	**£2·99**	4001	**27p**
LM317K	**£3·56**	4011	**28p**
LM317T	**£2·55**	4013	**55p**
LM324N	**79p**	4017	**95p**
LM380N	**99p**	4020	**£1·20**
LM381N	**£1·98**	4024	**76p**
LM382N	**£1·62**	4069	**31p**
LM386N	**£1·04**	4081	**29p**
LM387N	**£1·39**	4093	**89p**
LM389N	**£1·29**	4522	**£1·79**
LM1830	**£2·32**	40174	**£1·50**

¼W CARBON FILM RESISTORS
E12 SERIES. 1R-10M **1½p each**
MIN. HORIZ. PRESETS. 100R-4M7 **12p each**
MIDGET POTS. LINEAR. 47OR-4M7 **37p each**
LOG. 4K7-2M3 **38p each**
SWITCHED POTS. 4K7-1M. LIN. **75p.** LOG **76p**

POLYESTER (C280) CAPACITORS, 250V
10nF; 15nF; 22nF; 33nF; 47nF **7p** each. 68nF; 100nF **8p.** 150nF; 220nF **12p.** 330nF **15p.** 470nF **20p.** 680nF **28p.** 1μF **33p.** 1·5μF **49p.** 2·2μF **65p.**

ELECTROLYTIC CAPACITORS
AXIAL Leads: 1μF/16V **11p;** 1μF/63V, 1μF/100V **12p;** 2·2μF/63V, 3·3μF/63V, 4·7μF/63V **12p;** 10μF/16V **11p;** 10μF/25V, 10μF/63V **12p;** 22μF/10V, 22μF/25V **12p;** 22μF/63V **15p;** 33μF/40V, 47μF/25V **12p;** 47μF/40V **15p;** 47μF/63V **18p;** 100μF/16V **12p;** 100μF/25V **15p;** 100μF/40V **18p;** 100μF/63V **29p;** 220μF/10V **15p;** 220μF/25V **19p;** 470μF/16V **29p;** 470μF/25V **36p;** 470μF/40v **55p;** 680μF/16V **32p;** 1000μF/10v **30p;** 1000μF/16V **33p;** 1000μF/25V **46p;** 1000μF/40V **58p;** 1000μF/63V **79p;** 2200μF/10V **39p;** 2200μF/25V **64p;** 2200μF/63V **£1·10.**

OPTO
BPX25 **£2·24**
2N5777 **60p**
ORP12 **99p**
TIL32 **81p**
TIL78 **74p**

LEDS WITH CLIPS
3mm. Red **15p.** Green **18p.** Yellow **20p.**
5mm. Red **16p.** Green **28p.** Yellow **29p.**
FLASHING LED **78p**
RECTANGULAR. Red **58p**
MAINS PANEL. Neon **32p**

SPEAKERS. Miniature. 8 ohm **87p** 64-75 ohm **89p**
CRYSTAL EARPIECE **65p**
MAGNETIC EARPIECE **15p**
MONO HEADPHONES **£2·98**
STEREO HEADPHONES **£4·35**
TELEPHONE PICK-UP COIL **72p**
F.M. AERIAL **49p**
MIN. BUZZERS. 6V. **50p.** 9V. **£1·10.** 12V. **65p.**
PCB ASSEMBLY JIG **£11·98**
PCB ETCHING KIT **£4·98**
PLASTIC TWEEZERS **69p**
EUROBREADBOARD **£6·20**
BIMBOARD 1 **£6·48**
S. DEC **£3·98**

PP3 CLIPS **10p** **PP9 CLIPS** **11p**
PANEL METERS. 60 × 45mm. 50μA, 100μA, 1mA, 1A, 25V **£4·99** each
VEROBOARD 0·1" COPPER. 10 strips, 24 holes **£1·20** per 5
24S 37H. **78p.** 24S 50H. **89p.** 36S 37H. **89p.** 36S 50H. **99p.**
TERMINAL PINS **48p/100**
PIN INSERTION TOOL **£1·69** **SPOT FACE CUTTER** **£1·23**

MULTIMETER TYPE 1. 1,000 opv with probes. 2" × 3½" × 1" **£6·66**
MULTIMETER TYPE 2. 20,000 opv with transistor tester. **£14·75**
CROC CLIP TEST LEAD SET. 10 leads with 20 clips **99p**
CONNECTING WIRE PACK. 5 × 5yd coils **65p**
RESISTOR COLOUR CODE CALCULATOR **21p**
TOWERS INTERNATIONAL TRANSISTOR SELECTOR **£10·35**
AM-FM AIRCRAFT BAND PORTABLE RADIO **£8·98**
2 STATION DESK INTERCOM **£7·48** **3 STATION** **£8·98**
PLUG-IN POWER SUPPLY. 4·5V, 6V, 9V, 300mW **£3·89**
DIMMER SWITCH **£3·98**
PVC TAPE. 3 reels **34p**
DENTISTS INSPECTION MIRROR **£2·85**
JEWELLERS EYEGLASS **£1·50**
HAND MAGNIFIER. 3" **£2·99**
ILLUMINATED MAGNIFIER. 1½" **£1·14** 3" **£3·19**

GREENWELD

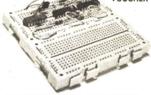
443D MILLBROOK ROAD, SOUTHAMPTON SO1 0HX
All prices include VAT—just add 40p post. Tel (0703) 772501

VEROBLOC BREADBOARD

New from Vero, this versatile aid for building and testing circuits can accommodate any size of IC. Blocs and be joined together. Bus strips on X & X axis—total 360 connexion points for just **£4·15.**

(Photo shows 2 blocs)

SAVE £1!!
ONLY £3·15
WITH VERO
VOUCHER



COMPONENT PACKS

K503 150 wirewound resistors from 1W to 12W, with a good range of values. **£1·75.**

K505 20 assorted potentiometers, all types including single, ganged, rotary and slider. **£1·70.**

K511 200 small value poly, mica, ceramic caps from a few pF to ·02μF. Excellent variety. **£1·20.**

K514 100 silver mica caps from 5pF to a few thousand pF. Tolerances from 1% to 10%. **£2·00.**

K516 Transistor Pack. Small signal NPN/PNP transistors in plastic package. Almost all are marked, full spec devices, but some have bent leads. Over 30 different types have been found by us, inc. BC184/212/238/307/328; BF196/7; ZTX107/8/9/342/450/550 etc. Look at the low price! 100 for **£3·00;** 250 for **£7·00;** 1000 for **£25.**

K520 Switch pack—20 different, rocker, slide, rotary, toggle, push, micro, etc. Only **£2·00.**

K521 Heatshrink pack—5 diff. sizes, each 200mm. **50p.**

COMPONENT CABINET IDEAL FOR THE NEWCOMER TO ELECTRONICS

Contains hundreds of brand new resistors, capacitors, transistors, diodes and I.C.'s. All useful values, carefully chosen to help the new constructor pursue his hobby without finding himself short of some vital parts.

All parts contained in clearly marked bags in a plastic storage cabinet 232 × 121 × 165mm with 9 drawers into which all parts can be neatly located.

If bought individually parts plus case would cost over **£50** but we are offering this for ONLY **£33·95** + **£1** p. & p.

Simply send a cheque or P/O for **£34·95** for immediate despatch.

CONTENTS:

200	¼ watt resistors
20	Wire wound resistors
70	Ceramic Capacitors
70	Mylar Capacitors
50	Polyester Capacitors
56	Electrolytic Capacitors
61	Transistors
12	I.C's
20	L.E.D.'s
55	Diodes and rectifiers

Altogether 614 components.

Plus FREE surprise gift.

OPTO/LINEAR

TIL311 Hexadecimal display with decoder, 0-9 and A-F. With data **£3·50.**
AD563KD D-A converter. Only **£3·50.**
FNA5220 2 digit ½" 7-seg display on PCB, CC. With data **£1·50.** 7-seg displays: FND360, 367, 501, all **50p;** 530, 847, 850, all **£1·50.** Regs, T03 case: 7924 **120p,** 7885 **100p,** 7808 **100p,** 7912 **100p,** 78CB **230p.** Others on B/L 13 Op-Amps: μA4136 **130p;** μA776 **145p** μA777 **300p;** μA318 **245p.**
Isolators: FCD831, IL15, TIL118, all **60p.**

AMAZING! COMPUTER GAMES PCB's FOR PEANUTS!!

A bulk purchase of PCB's from several well known computer games including Battleships, Simon, Logic 5 and Starbird enable us to offer these at incredibly low prices:

"STARBIRD"
Gives realistic engine sounds and flashing laser blasts—accelerating engine noise when module is pointed up, decelerating noise when pointed down. Press contact to see flash and hear blast of lasers shooting. PCB tested and working complete with speaker and batt clip. (needs PP3 battery). Only **£2·95—2** for **£5.** For details of other games, send SAE.

PANELS

Z521 Panel with 16236 (2N3442) on small heat sink, 2N2223 dual transistor, 2 BC108, diodes, caps, resistors, etc. **60p.**

Z482 Potted Oscillator Module works from 1·20V, can be used as LED flasher (3V min). Supplied with connection data, suitable R, C & LED. **£1·00.**

Z527 Reed relay panel—contains 2 × 6V reeds, 6 × 2S030 or 2S230, 6 × 400V rects + Rs. **50p.**

Z529 Pack of ex-computer panels containing 74 series ICs. Lots of different gates and complex logic. All ICs are marked with type no. or code for which an identification sheet is supplied. 20 ICs **£1·00;** 100 ICs **£4·00.**

A504 Black case 50 × 50 × 78mm with octal base. PCB inside has 24V reed relay, 200V 7A SCR, 4 × 5A 200V rects, etc. **60p.**

Z535 RAM panel—36 2102A-4 static RAM's, also 28 other chips inc 7 × LS75, 4 × 74368, 3 × 74180 etc. Only **£5·00.**

Z536 As above, but extra 15 74LS chips **£6·00.**

THE SPECTACULAR 1981 GREENWELD Component Catalogue

Bigger and better than ever!!!

- ★ 60p discount vouchers
- ★ First Class reply paid envelope
- ★ Free Bargain List
- ★ Priority Order Form
- ★ VAT inclusive prices
- ★ Quantity prices for bulk buyers

SEND 75p FOR YOUR COPY NOW!!

TEACH-IN 82

SEE OUR AD ELSEWHERE IN THIS ISSUE FOR FULL DETAILS AND PRICES!!!

CAPACITOR BARGAINS

2200μF 100V cans 77 × 35mm dia. **75p;** 10/**£5·50;** 220μF 10V axial **5p;** 100 **£2·30;** 1000 **£16;** 400+100μF 275V 102 × 44mm dia. **75p;** 10 **£5·50;** 200μF 350V, 100 + 100 + 50μF 300V can 75 × 44mm dia **40p;** 10/**£3;** 100/**£20** 100uF 25V Axial **£3**/100.

4 TERMINAL REGS

μA78MG In power mini-dip case 5-30V at ½A. **£1·00.**
μA79MG Negative version of above. **£1·20.**
Only 4 extra components required (**50p** extra) to make a fully variable supply!! Data supplied.

1W AMP PANELS

A011 Compact audio amp intended for record player on panel 95 × 65mm including vol. control and switch, complete with knobs. Apart from amp circuitry built around LM380N or TBA820M, there is a speed control circuit using 5 transistors. 9V operation, connexion data supplied. ONLY **£1·50.**

VU METERS

V006 Very attractive 55 × 48mm scaled —20 to +5dB. 250μA movement. Only **£1·75,** or **£3·00** pair.

OP-AMP PSU KIT

A198 All parts + instructions to make a 50mA +15, 0, —15V supply from mains input. Only **£1·95.**

COPPER CLAD BOARD

K522 All pieces too small for our etching kits. Mostly double sided fibreglass. 250gm (approx. 110 sq ins) for just **£1·00.**

JOB LOT OF COMPONENTS

9500 1N4006; 10000 ·033/50; 22000 10pF/50; 15000 ·22/12; 11000 270pF/50; 15000 68pF/50. 30000 various resistors. Total 112,500 components for **£400** inc. VAT & carr.

12 VOLT INDICATORS

Ideal for light chasers, etc. Miniature 12V 75mA wire ended lamps in yellow, red, green, blue and clear. **10p** each. 20 each colour, total 100 for **£5·50.**

COMPUTERS ● AUDIO ● RADIO ● MUSIC ● LOGIC ● TEST GEAR ● CB ● GAMES ● KITS

BREAD BOARD 81

Wednesday	11th November	10 a.m.-6 p.m.
Thursday	12th November	10 a.m.-8 p.m.
Friday	13th November	10 a.m.-6 p.m.
Saturday	14th November	10 a.m.-6 p.m.
Sunday	15th November	10 a.m.-4 p.m.

COMPONENTS ● DEMONSTRATIONS ● SPECIAL OFFERS ● MAGAZINES ● BOOKS

ROYAL HORTICULTURAL SOCIETY'S
NEW HALL, GREYCOAT STREET,
WESTMINSTER, LONDON S.W.1.

17,000 PEOPLE CAN'T BE WRONG

For 5 days last year they packed the RHS halls for Breadboard '80. All the leading companies were there.....

.....and they're back again this year for BREADBOARD '81.....with larger stands and wider gangways.

Whether you're buying or just browsing, BREADBOARD '81 has something to offer you. The top electronics magazines will be there.

If you're interested in kits, components or computing, BREADBOARD '81 covers it all..... books, bargains and demonstrations. It's all happening at BREADBOARD '81.

Cost of entry will be £2.00 for adults, and £1.00 for children under 14 yrs and O.A.P.s.

To avoid queueing, Advance tickets will be available from:
Advance Tickets BB '81,
Modmags Ltd, 145 Charing Cross Road,
London WC2H 0EE

Special Advance Booking Price
Adults £1.75, Children under 14 yrs and O.A.P.s 80p

Please send .... tickets @ £1 75 .... tickets @ 80p

To ....

....

....

I enclose PO/cheque for £ ....

Advance tickets MUST be ordered BEFORE 20th October 1981.

TECHNICAL TRAINING IN ELECTRONICS AND TELECOMMUNICATIONS

ICS can provide the technical knowledge that is so essential to your success; knowledge that will enable you to take advantage of the many opportunities open to you. Study in your own home, in your own time and at your own pace and if you are studying for an examination ICS guarantee coaching until you are successful.

City and Guilds Certificates:
Telecommunications Technicians
Radio, TV, Electronics Technicians
Technical Communications
Radio Servicing Theory
Radio Amateurs
Electrical Installation Work
MPT Radio Communications Certificate

Diploma Courses:
Colour TV Servicing
Electronic Engineering and Maintenance
Computer Engineering and Programming
Radio, TV, Audio Engineering and Servicing
Electrical Engineering, Installation and Contracting

POST OR PHONE TODAY FOR FREE BOOKLET

ICS **To: International Correspondence Schools**

Dept268M Intertext House, London SW8 4UJ or telephone 622 9911

Subject of Interest ....
Name ....
Address ....
.... **Tel:** .... **Age:** ....

The ONE catalogue you MUST have!

- About 2,000 items clearly listed.
- Profusely illustrated throughout.
- Large A-4 size pages.
- Bargain list, order form and 2 coupons each worth 25p if used as directed, all supplied free.

Price £1, plus 50p for post, packing and insurance.

Send cheque or P.O. for £1·50.

HOME RADIO Components Ltd
Dept. EE P.O. Box 92, 215 London Road,
Mitcham, Surrey. 01-543 5659

JOIN UP WITH LITESOLD

Litesold's new 'L' Series soldering iron — now at a bargain price. Outstanding performance. Lightweight. Easy to maintain. Elements are enclosed in Stainless Steel shafts, insulated with mica and ceramic. Non-seize interchangeable bits, choose from 'copper' or 'long life'. A very special tool at a very special 'direct' price. Just £5.22 for iron fitted with 3.2mm copper bit. Just £2.27 for 3 spare copper bits (1.6; 2.4; 4.7). A mere £4 for professional spring stand! **Or buy the lot for £10.34 and save 10%.**

BARCLAYCARD VISA

Buy it with Access

£5·22

LITESOLD
LIGHT SOLDERING DEVELOPMENTS LTD

All prices inc. VAT P.&P.

Write today. Send Cheque/P.O. to Litesold, 97-99 Gloucester Road, Croydon CR0 2DN or phone 01-689 0574 for Barclaycard/Access sales.

DIY MUSIC & EFFECTS KITS

AUTOWAH UNIT

Automatically gives Wah or Swell sounds with each guitar note played.

Kit order code SET 58 £16·04

GUITAR EFFECTS UNIT

Modulates the attack, decay and filter characteristics of a signal from most audio sources, producing 8 different switchable sounds that can be further modified by manual controls.

Kit order code SET 42 £14·11

GUITAR FREQUENCY DOUBLER

Produces an output one octave higher than the input. Inputs and outputs may be mixed to give greater depth.

Kit order code SET 98 £10·55

GUITAR MULTIPROCESSOR

An extremely versatile sound processing unit capable of producing, for example, flanging, vibrato, reverb, fuzz and tremolo as well as other fascinating sounds. May be used with most electronic instruments. Some SW's not incl. in kit—see list for selection.

Kit order code SET 85 £72·90

GUITAR OVERDRIVE

Sophisticated versatile fuzz unit incl. variable controls affecting the fuzz quality whilst retaining the attack and decay, and also providing filtering.

Kit order code SET 56 £19·60

GUITAR PRACTISE AMPLIFIER

A 3 watt mains powered amplifier suitable for instrument practise or as a test gear monitor. Drives 8 or 15 ohm speakers (not incl. in kit).

Kit order code SET 106 £18·72

GUITAR SUSTAIN

Maintains the natural attack whilst extending note duration.

Kit order code SET 75 £11·77

PHASER

An automatically controlled 6 stage phasing unit with internal oscillator. Depth can be increased with extension.

Main kit code SET 88 £18·34
Extension kit EXT 88 £7·31

PHASING & VIBRATO

Includes manual and automatic control over the rate of phasing & vibrato. Capable of superb full sounds. A separate power supply is included.

Kit order code SET 70 £42·85

SMOOTH FUZZ

As the name implies! Order code SET 91 £11·68

SPLIT-PHASE TREMOLO

The output of the internal generator is phase-split and modulated by an input signal. Output amplitudes, depth & rate are panel controlled. The effect is similar to a rotary cabinet.

Kit order code SET 102 £27·55

SWITCHED TONE TREBLE BOOST

Provides switched selection of 4 preset tonal responses.

Kit order code SET 89 £10·51

AUDIO EFFECTS UNIT

A variable siren generator that can produce British & American police sirens, Star-Trek red alert, heart beat monitor sounds, etc.

Kit order code SET 105 £12·91

FUNNY TALKER

Incorporates a ring modulator, chopper & frequency modulator to produce fascinating sounds when used with speech & music.

Kit order code SET 99 £15·43

WIND & RAIN EFFECTS

As the name says! Order code SET 28 £9·94

DISCOSTROBE

A 4-channel 200-watt light controller giving a choice of sequential, random or full strobe mode of operation.

Kit order code SET 57 £36·52

LIST

Send stamped addressed envelope with all U.K. requests for free list giving fuller details of PCBS, kits and other components. Overseas enquiries for list—Europe send 50p, other countries send £1·00.

ACCESS BARCLAYCARD VISA AMERICAN EXPRESS

TERMS: C.W.O., Mail Order or Collection by appointment. Tel. 01-302-6184 (Mon-Fri).

KIMBER-ALLEN KEYBOARDS

Claimed by the manufacturers to be the finest moulded plastic keyboards available. All octaves are C-C, the keys are plastic, slope fronted, spring loaded, fitted with actuators and mounted on a robust aluminium frame.
3-Octave **£25·50**, 4-Oct **£32·25**, 5-Oct **£39·50**. Gold-clad contacts (1 needed for each note) type GJ (SPCO) **33p** each. Type GB (2-PR n/o) **38p** each.

CHOROSYNTH

A standard keyboard version of the published Elektor 30-note chorus synthesiser with an amazing variety of sounds ranging from violin to cello and flute to clarinet amongst many others.

Kit plus keyboard & contacts SET 100 £114·12

FORMANT SYNTHESISER

For the more advanced constructor who puts performance first, this is a very sophisticated 3-octave synthesiser with a wealth of facilities, including 6 oscillators, 3 waveform converters, voltage controlled filter, 2 envelope shapers and voltage controlled amplifier. Case and hardware not included—see our lists for further details.

Kit plus keyboard & contacts SET 66 £323·35

P.E. MINISONIC SYNTHESISER

A very versatile 3-octave portable mains operated synthesiser, with 2 oscillators, voltage controlled filter, 2 envelope shapers, ring modulator, noise generator, mixer, power supply and sub-min toggle switches to select the functions. A case is excluded, but the text gives comprehensive constructional details.

Kit plus keyboard & contacts SET 38 £169·69

PRICES INCLUDE
VAT @ 15% & U.K. P. & P.

NEW KIT MAKE-UP
—SEE BELOW

128—NOTE SEQUENCER

Enables a voltage controlled synthesiser, such as the P.E. Minisonic, to automatically play pre-programmed tunes of up to 32 pitches and 128 notes long. Programs are initiated from the 4-octave keyboard and note length and rhythmic patter are externally variable.

Kit plus keyboard & contacts SET 76 £114·09

16—NOTE SEQUENCER

Sequences of up to 16 notes long may be pre-programmed by the panel controls and fed into most voltage controlled synthesisers. The notes and rhythms may be changed whilst playing, making it more versatile than the name would suggest.

Kit order code SET 86 £60·13

DIGITAL REVERB UNIT

A very advanced unit using sophisticated I.C. techniques instead of noise-prone mechanical spring lines. The basic delay range of 24 to 90MS can be extended up to 450MS using the extension unit. Further delays can be obtained using more extensions.

Main kit order code SET 78 £67·22
Extension kit EXT 78 £45·94

RING MODULATOR

Compatible with the Formant and most other synthesisers.

Kit order code SET 87 £11·69

WAVEFORM CONVERTER

Converts saw-tooth waveform into sinewave, mark-space sawtooth, regular triangle, or squarewave with variable mark-space. Ideally one should be used with each synthesiser oscillator.

Kit order code SET 67 £20·13

BASIC COMPONENT SETS

Include specially designed drilled & tinned fibreglass printed circuit boards, all necessary resistors, capacitors, semiconductors, potentiometers, and transformers. They also include basic hardware such as knobs, sockets, switches, a nominal amount of wire and solder, a photocopy of the original published text, and unless otherwise stated, a robust aluminium box. Most parts may be bought separately. For fuller kit and component details see our current lists.

Kits originate from projects published in PE, EE, and Elektor.

RHYTHM GENERATORS

Two different kits—The control units are designed around the M252 and M253 rhythm-gen chips which produce pre-programmed switch-selectable rhythms driving 10 effects instrument generators feeding into a mixer.

12-Rhythm unit SET 103-253 £64·10
15-Rhythm unit SET 103-252 £57·26

6—CHANNEL MIXER

A high specification stereo mixer with variable input impedances. Specs given in our lists. The kit excludes some SW's—see lists for selection. The extension gives two extra channels.

Main kit code SET 90 £88·99
Extension kit EXT 90 £11·74

3—CHANNEL STEREO MIXER

Full level control on left and right or each channel, and with master output control and headphone monitor.

Kit order code SET 107 £18·68

3—MICROPHONE STEREO MIXER

Enables stereo live recordings to be made without the 'hole in the middle' effect. Independent control of each microphone.

Kit order code SET 108 £12·31

HEADPHONE AMPLIFIER

For use with magnetic, ceramic or crystal pick-ups tapedeck, or tuner, and for most headphones. Designed with RIAA equalisation.

Kit order code SET 104 £18·10

VOICE OPERATED FADER

For automatically reducing music volume during disco talk-over.

Kit order code SET 30 £7·80

DYNAMIC NOISE LIMITER

Very effective stereo circuit for reducing noise found in most tape recordings.

Kit order code SET 97 £12·67

DYNAMIC RANGE LIMITER

Automatically controls sound output levels.

Kit order code SET 62 £9·51

TUNING FORK

Produces 84 switch-selectable frequency-accurate tones with led monitor displaying beat-note adjustments.

Kit order code SET 46 £34·56

TUNING INDICATOR

A simple octave frequency comparitor for use with synthesisers where the full versatility of KIT46 is not needed.

Kit order code SET 69 £14·41

PULSE GENERATOR

Produces controllable pulse widths from 100NS to 2Sec. Variable frequency range of 0·1Hz to 100KHz.

Kit order code SET 115 £21·45

SIGNAL TRACER & GENERATOR

Allows audio signals to be injected into circuits under test, and for tracing their continuity. Includes frequency & level controls.

Kit order code SET 109 £15·31

WAVEFORM GENERATOR

Provides sine, square and triangular wave outputs variable between 1Hz & 100KHz up to 10V P-P.

Kit order code SET 112 £21·58

SPEECH PROCESSOR

Improves the inteligibility of noisy or fluctuating speech signals, and ideal for inserting into P.A. or C.B. radio systems.

Kit order code SET 110 £9·21

FREQUENCY COUNTER

A 4-digit counter for 1Hz to 99KHz with 1Hz sampling rate.

Kit order code SET 79 £43·30

EXPOSURE TIMER

Controls up to 750 watts in 0·5sec steps up to 10 minutes, with built-in audio alarm.

Kit order code SET 93 £36·44

EXPORT ORDERS ARE WELCOME

Postage rates are shown in our lists. All payments must be cash-with-order, in sterling by international money order or through an english bank. We do not offer a C.O.D. service. To obtain list—Europe send 50p, other countries send £1·00.

MORE KITS AND
COMPONENTS
ARE ON OUR LISTS

Prices are correct at time of press. E. & O.E. subject to availability.

PHONOSONICS • DEPT EE16 • 22 HIGH STREET • SIDCUP • KENT DA14 6EH

MUSICAL MICRO 24 TUNE DOOR BELL

BUILD THE WORLD FAMOUS CHROMA-CHIME

Give your friends a warm welcome. Yes, think how delighted and amazed they will be to hear the musical Chroma-Chime play when they press your button!

The Chroma-Chime uses a microcomputer to play 24 well-known tunes. The kit is simplicity itself for ease of construction. Absolutely everything needed is supplied, including:

★ Resistors, Capacitors, Diodes, Transistors, I.C. Socket and all hardware
★ Texas Instruments TMS 1000 microcomputer
★ Comprehensive kit manual with full circuit details

ONLY £11.95 + 75p p&p UK ONLY

Ready built version also available. Special offer price £15.95 incl. p&p.

Plays 24 well-known tunes including:
Star Spangled Banner, William Tell Overture, Greensleeves, Rule Britannia, Colonel Bogey, Oh come all ye faithful, plus many other popular tunes.

★ No previous microcomputer experience necessary
★ All programming retained is on chip ROM
★ Fully guaranteed
★ **Ideal present any time**

TMS 1000N

–MP0027A Micro-computer chip available separately if required. Full 24 tune spec device fully guaranteed.

This unique chip can be used not only for electronic door chimes but for other projects requiring musical output:
Car Horns **Musical Boxes** **Alarms**
Amusement Machines **Public Address etc**
Free applications manual and data supplied with device
(Or 30p separately)

New low price only **£4.95** inc p&p
or 3 for £12.50 incl. p&p.

ALL CHROMATRONICS PRODUCTS SUPPLIED WITH MONEY BACK GUARANTEE
PLEASE ALLOW 7-21 DAYS FOR DELIVERY

EE/10/81

Please send me:
TO: CHROMATRONICS, RIVER WAY, HARLOW, ESSEX.
NAME ______________________________
ADDRESS ______________________________

I enclose cheque/PO value £ ______________________________
or debit my ACCESS/BARCLAYCARD account no.
☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐
Signature ______________________________

CHROMATRONICS

CB
Citizens' Band
BRITAIN'S LEADING CBMONTHLY
SILVER SCREEN
Could CB save your business £3000? See inside
Exclusive Review! Three New
Alternative Telephones
Inside CB New Starter Series
DIY Emergency CB Aerial
OUT NOW! AT YOUR NEWSAGENT

In the **OCTOBER ISSUE** GET YOUR *FREE* CB CALCULATOR giving all the Ten Four codes.

FEATURES INCLUDE

- A special multi Rig review
- A microphone survey
- A Citizens Band Show preview
- Legislation news
- and Inside CB will cover how antennas work.

SUPER VALUE PACKS AND COMPONENTS

P1. 50	Ass. Electrolytics Caps......	**80p**	P 9. 20	High Voltage Discs. 1KV-8KV 270pf-470pf	**80p**
P2. 80	Polyester, Polycarbonate, Polypropylene	**80p**	P10.	18 High Voltage Discs 1KV-8KV 1000pf-·01uf	**80p**
P3. 100	Small Cer. Discs	**80p**	P11. 10	20mm in line fuse holders ..	**80p**
P4. 80	Square Cer. Plates	**80p**	P12. 10	5 pin din chassis sockets....	**80p**
P5. 50	Polystyrene caps. 5·6pf-3900pf	**80p**	P13. 150	Axial ¼ watt resistors........	**80p**
P6. 45	Polystyrene caps. 4700pf-·047uf	**80p**	P14. 5	100K Multitone trimmers for Thorn Varicap tuners	**80p**
P7. 20	Silver Mica 5·6pf-220pf	**80p**	P15.	One of each Tant Bead Cap. as listed below......Qty 20	**£3·50**
P8. 18	Silver Mica 270pf-0047uf	**80p**			

DIODES
1N4001; **·04p.** 1N4002; **·04p.** 1N4003; **·04p.** 1N4004; **·05p.** 1N4005; **·05p.** OA90; **·06p.** OA91; **·06p.**

TANT BEAD CAPACITORS
·1/35v, ·22/35v, ·33/35v, ·47/35v, ·68/35v, 1/35v **10p** each. 2·2/16v, 3·3/16v, 4·7/6v **·12p.** 4·7/35v, 6·8/25v **·14p.** 6·8/35v **·15p.** 10/16v **·16p.** 22uf/6·3v **·16p.** 22/10v **·20p** 22/16v **·25p.** 33/10v **·25p.** 47/6v **·25p.** 47/16v **·50p.** 100/16v **·65p.**

Polystyrene Caps. from **·03p.** Low Voltage discs from **·03p.** Silver Mica from **·10p.** Etc., Etc. Lists enclosed with first order or S.A.E. Post and packing add **·20p** per pack or **·20p** on orders for components only.

C. H. J. SUPPLIES
Orders over £5·00 Post Free. VAT inclusive.
4 STATION ROAD, CUFFLEY, HERTS. Tel: 01-440 8959.

POPS COMPONENTS

38/40 Lower Addiscombe Road, Croydon CR0 6AA 01-688-2950
★ POPS SPECIAL OFFERS THIS MONTH ★
Free L.E.D.s + LIST with every order!
P. & P. 50p.

AUDIO & RADIO PANELS, damaged or incomplete, Thorn manufactured, hundreds of modern useable components including PB switches, transistors, Resistors, Caps, Tants & Electrolytics. Mini Toko IF & OSC Coils. 3lb Lots. **£6·00.**

SOLAR CELLS. Give 20mA at ½v. **£1·50** each.
OFFER. Demo Kit: 2 cells and motor for **£4·50.**

12v MINI RELAYS (Continental type)
2p × over 700Ω—**50p** each   4p × over 430Ω—**80p** each.

VIDEO—R.F. MODULATORS Calibrated channel 36 (625 Line U.H.F.) 9v supply 2½ metre R.F. lead with TV Ae Plug use for video games, etc. **£2·50** each or 10 for **£18·00!**

MICRO SWITCHES Pack of three different types. **£1·00.**

TELESCOPIC Ae, with 9 segments, hinged, plugs into 3·5mm skt. **£1·00.**

12v TRANSFORMERS at 400mA on a panel with rects. O.K. for 12v mains adaptor for radio cassettes, etc. **£1·10.** Boxes to suit **50p** each.
Lots more bargains! Full list sent with orders received, or send S.A.E.

Team Up With TH Electronics

for top quality components, innovative kits,
FAST SERVICE AND LOW, LOW PRICES

Prices do not include VAT. Add 50p P&P + 15% VAT to total. Overseas customers add £1·50 (Europe) £4 (elsewhere). Access and Barclaycard welcome. Send sae for price list and with enquiries. Shop open: 9-5 (Mon-Fri) 10-4 (Sat).

11 BOSTON ROAD, LONDON, W7 3SJ.
Tel: 01-579-9794/2842

INTEGRATED CIRCUITS

555 Timer	**21p**
556 Dual 555 Timer	**40p**
741 Op. Amp.	**19p**
AD590 Constant current Temperature Sensor	**2.75**
AY-5-1224 Clock	**2.60**
AY-5-1230 Clock/Timer	**4.50**
AY-3-1270 Thermometer	**8.20**
CA3080 Transconductance OpAmp	**72p**
CA3130 CMOS Op. Amp.	**75p**
CA3140 CMOS Op. Amp.	**43p**
ICL7106 DVM (LCD drive)	**7.00**
ICM7555 CMOS 555 Timer	**79p**
LM377 Dual 2W Amp.	**1.45**
LM379S Dual 6W Amp.	**3.50**
LM380 2W Audio Amp.	**80p**
LM382 Dual low noise pre-amp.	**1.00**
LM386 250mW low voltage amp.	**75p**
LM1830 Fluid Level Detector	**1.50**
LM2917 F-V converter (14-pin)	**1.60**
LM3909 LED Flasher/oscillator	**60p**
LM3911 Thermometer	**1.20**
LM3914 Dot/Bar driver (linear)	**2.10**
LM3915 Dot/Bar driver (log.)	**2.20**
LS7220 Electronic Combination Lock with "Save" feature	**2.75**
LS7225 Electronic Combination Lock with tamper output	**2.60**
MM74C911 4-digit display controller	**6.50**
MM74C915 7-segment BCD converter	**96p**
MM74C926 Counter/7 seg. output	**4.50**
S566B Touchdimmer	**2.50**
SL440 AC Power Control	**1.75**
SL441 Burst Fire Controller	**1.35**
SN76447 Complex Sound Generator	**1.75**
TBA800 5W Audio Amp.	**68p**
TBA810AS 7W Audio Amp.	**1.00**
TMS1121 Clock/7 day Timer	**8.50**
Data for TMS1121	**50p**

THE KEY TO YOUR SECURITY IS IN OUR LOCK

If you have problems with people tampering with your car, electrical and electronic equipment, or if you are just in a habit of forgetting your door keys, we have just the kit for you. Our ELECTRONIC LOCK KIT includes a 10-way keyboard and a special IC which provides a 750mA output to drive a solenoid or relay (not supplied) when four keys are depressed in the correct sequence. This gives over 5,000 possible combinations! The sequence is pre-wired and may be easily changed by means of a small plug and socket. A "SAVE" function is also available enabling the open code to be stored (especially useful in a car when it is left in a garage for servicing as the open code need not be disclosed). Size: 7 × 6 × 3 cms. Power consumption is 40uA at 5V to 15V d.c. At only **£10·50** + VAT, it will make a smaller hole in your pocket than a bunch of keys!

LOCK I.C.s LS7220 with SAVE memory **£2·75.** LS7225 with latched and momentary outputs and a tamper output **£2·60.** Data only **10p.** Electric Lock Mechanism suitable for use with existing door locks and the above electronic lock kit **£12·50.**

TEACH-IN '82

£13.50 + VAT

Based on ICL7106 DVM chip and a 3½ digit liquid crystal display. The kit will form the basis of a digital multimeter – only a few additional switches and resistors required (details supplied) or make a sensitive digital thermometer (–50°C to 150°C) reading to 0.1°C. The basic kit has a sensitivity for fullscale of 200mV, automatic polarity and runs from a 9V PP3 battery.

£13.50 · **VAT**

EE Minilab	**£16·50**
Kit of components for parts 1 to 6	**£7·80**
Special Price if above kits purchased together	**£23·50**

The above kits include all the components specified in the Teach-In 82 projects for ICs specified. Don't forget to send the Vero £1 voucher for a further discount. Prices do not include VAT.

DISCO LIGHTING KITS

Each unit has 4 channels (rated at 1KW at 240V per channel) which switch lamps to provide sequencing effects, controlled manually or by an optional opto isolated audio input.

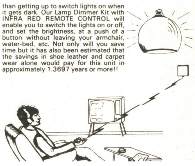
DL1000K
This kit features a bi-directional sequence, speed of sequence and frequency of direction change being variable by means of potentiometers. Incorporates meter dimming control **£14·60**

DLZ1000K
A lower cost version of the above featuring undirectional channel sequence with speed variable by means of a preset pot. Outpots switched only at mains zero crossing points to reduce radio interference to minimum **£8·00**

Optional Opto Input
DLA1 **60p**

YOU MUST HAVE BETTER THINGS TO DO

than getting up to switch lights on when it gets dark. Our Lamp Dimmer Kit with INFRA RED REMOTE CONTROL will enable you to switch the lights on or off, and set the brightness, at a push of a button without leaving your armchair, water-bed, etc. Not only will you save time but it has also been estimated that the savings in shoe leather and carpet wear alone would pay for this unit in approximately 1.3697 years or more!!

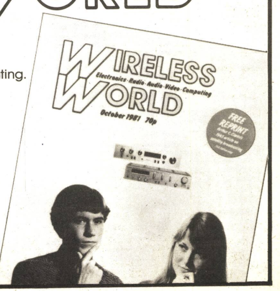


This unit has, of course, considerable practical uses, especially for the old, infirm and disabled. It works like a conventional dimmer, enabling you to switch the lights on or off, or to dim them to whatever brightness you require, by touch or remotely using the hand-held infra red transmitter. When assembled, it fits into a plaster depth box to replace your conventional switch or dimmer with no rewiring.

TDR300K Dimmer Kit **£14.30** and MK6 Transmitter Kit **£4.20.** We also still sell our highly popular TD300K Touch Dimmer Kit at **£7.00** and the LD300K rotary controlled Dimmer Kit at only **£3.50** (plus VAT to above prices).
All kits contain all necessary components and full assembly instructions. You only need a soldering iron, cutters and a few hours.

NEW LOOK WIRELESS WORLD

Electronics·Radio·Audio·Video·Computing



Look out for Wireless World's striking new front cover.
Editorial now includes electronics, radio, audio, video and computing.

FREE THIS MONTH

Exclusive reprint of Arthur C. Clarke's 1945 article on satellite broadcasting.

PLUS

Hi-Fi Article—how to distinguish between amplifier and loudspeaker sound.
Micro Article—how to connect microprocessors to other electrical/electronic equipment.
Many other regular articles including world of amateur radio, news of the month, circuit ideas, new products and job opportunities.

October issue out now only 70p.

Sinclair ZX81 Personal Comp

the heart of a system that grows with you.

1980 saw a genuine breakthrough – the Sinclair ZX80, world's first complete personal computer for under £100. Not surprisingly, over 50,000 were sold.

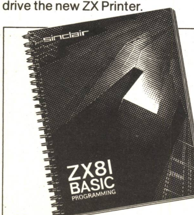
In March 1981, the Sinclair lead increased dramatically. For just £69.95 the Sinclair ZX81 offers even more advanced facilities at an even lower price. Initially, even we were surprised by the demand – over 50,000 in the first 3 months!

Today, the Sinclair ZX81 is the heart of a computer system. You can add 16-times more memory with the ZX RAM pack. The ZX Printer offers an unbeatable combination of performance and price. And the ZX Software library is growing every day.

Lower price: higher capability
With the ZX81, it's still very simple to teach yourself computing, but the ZX81 packs even greater working capability than the ZX80.

It uses the same micro-processor, but incorporates a new, more powerful 8K BASIC ROM – the 'trained intelligence' of the computer. This chip works in decimals, handles logs and trig, allows you to plot graphs, and builds up animated displays.

And the ZX81 incorporates other operation refinements – the facility to load and save named programs on cassette, for example, *and* to drive the new ZX Printer.



New BASIC manual

Every ZX81 comes with a comprehensive, specially-written manual – a complete course in BASIC programming, from first principles to complex programs.

Kit: £49.95

Higher specification, lower price – how's it done?
Quite simply, by design. The ZX80 reduced the chips in a working computer from 40 or so, to 21. The ZX81 reduces the 21 to 4!

The secret lies in a totally new master chip. Designed by Sinclair and custom-built in Britain, this unique chip replaces 18 chips from the ZX80!

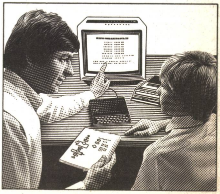
New, improved specification

- Z80A micro-processor – new faster version of the famous Z80 chip, widely recognised as the best ever made.
- Unique 'one-touch' key word entry: the ZX81 eliminates a great deal of tiresome typing. Key words (RUN, LIST, PRINT, etc.) have their own single-key entry.
- Unique syntax-check and report codes identify programming errors immediately.
- Full range of mathematical and scientific functions accurate to eight decimal places.
- Graph-drawing and animated-display facilities.
- Multi-dimensional string and numerical arrays.
- Up to 26 FOR/NEXT loops.
- Randomise function – useful for games as well as serious applications.
- Cassette LOAD and SAVE with named programs.
- 1K-byte RAM expandable to 16K bytes with Sinclair RAM pack.
- Able to drive the new Sinclair printer.
- Advanced 4-chip design: micro-processor, ROM, RAM, plus master chip – unique, custom-built chip replacing 18 ZX80 chips.

Built: £69.95

Kit or built – it's up to you!
You'll be surprised how easy the ZX81 kit is to build: just four chips to assemble (plus, of course the other discrete components) – a few hours' work with a fine-tipped soldering iron. And you may already have a suitable mains adaptor – 600 mA at 9 V DC nominal unregulated (supplied with built version).

Kit and built versions come complete with all leads to connect to your TV (colour or black and white) and cassette recorder.



uter-

```
10 FOR I=1 TO 22
20 PRINT "/"
30 NEXT I
40 PRINT AT 10,0;"--------------------------------"
50 FOR I=0 TO 63
60 PLOT I,22+20*SIN (I/32*PI)
```

Available now-the ZX Printer for only £49.95

Designed exclusively for use with the ZX81 (and ZX80 with 8K BASIC ROM), the printer offers full alphanumerics *and* highly sophisticated graphics.

A special feature is COPY, which prints out exactly what is on the whole TV screen without the need for further intructions.

At last you can have a hard copy of your program listings – particularly useful when writing or editing programs.

And of course you can print out your results for permanent records or sending to a friend.

Printing speed is 50 characters per second, with 32 characters per line and 9 lines per vertical inch.

The ZX Printer connects to the rear of your computer – using a stackable connector so you *can* plug in a RAM pack as well. A roll of paper (65 ft long x 4 in wide) is supplied, along with full instructions.

16K-byte RAM pack for massive add-on memory.

Designed as a complete module to fit your Sinclair ZX80 or ZX81, the RAM pack simply plugs into the existing expansion port at the rear of the computer to multiply your data/program storage by 16!

Use it for long and complex programs or as a personal database. Yet it costs as little as half the price of competitive additional memory.

With the RAM pack, you can also run some of the more sophisticated ZX Software – the Business & Household management systems for example.

How to order your ZX81

BY PHONE – Access, Barclaycard or Trustcard holders can call 01-200 0200 for personal attention 24 hours a day, every day.

BY FREEPOST – use the no-stamp-needed coupon below. You can pay by cheque, postal order, Access, Barclaycard or Trustcard.

EITHER WAY – please allow up to 28 days for delivery. And there's a 14-day money-back option. We want you to be satisfied beyond doubt – and we have no doubt that you will be.

To: Sinclair Research Ltd, FREEPOST 7, Cambridge, CB2 1YY.

Qty	Item	Code	Item price £	Order Total £
	Sinclair ZX81 Personal Computer kit(s). Price includes ZX81 BASIC manual, excludes mains adaptor.	12	**49.95**	
	Ready-assembled Sinclair ZX81 Personal Computer(s). Price includes ZX81 BASIC manual and mains adaptor.	11	**69.95**	
	Mains Adaptor(s) (600 mA at 9 V DC nominal unregulated).	10	**8.95**	
	16K-BYTE RAM pack.	18	**49.95**	
	Sinclair ZX Printer.	27	**49.95**	
	8K BASIC ROM to fit ZX80.	17	**19.95**	
	Post and Packing.			**2.95**

☐ Please tick if you require a VAT receipt TOTAL £________

*I enclose a cheque/postal order payable to Sinclair Research Ltd, for £________

*Please charge to my Access/Barclaycard/Trustcard account no.

*Please delete/complete as applicable.

Please print.

Name: Mr/Mrs/Miss

Address:

FREEPOST – no stamp needed. Offer applies to UK only. EVE 10

sinclair ZX81

6 Kings Parade, Cambridge, Cambs., CB2 1SN.
Tel: (0276) 66104 & 21282.

Wheel of Fortune	ZB164	Aug. 81	£27·50
Simple P.H. Meter	ZB165	Aug. 81	£22·00
LED Sand Glass	ZB162	Aug. 81	£5·00
Morse Practice Oscillator	ZB163	Aug. 81	£10·95
Door Alarm	ZB166	Aug. 81	£6·00
CMOS Metronome	ZB167	Aug. 81	£6·25
Xenon Strobe Lamp	ZB161	July 81	£18·50
Combination Lock	ZB160	July 81	£13·75
Electronic Multimeter	ZB159	July 81	£32·50
*Tremolo Unit	ZB157	June 81	£8·25
Loop Aerial Crystal Set	ZB158	June 81	£5·25
Darkroom Timer	ZB155	June 81	£4·00
Tape Auto Start	ZB156	June 81	£10·25
Audio Test Set	ZB152	May 81	£46·00
Soil Moisture Indicator	ZB154	May 81	£3·95
Phone Bell Repeater or Baby Alarm	ZB153	May 81	£5·25
Guitar Headphone Amplifier	ZB151	May 81	£4·00
Lights Reminder or Ignition Locator	ZB150	May 81	£5·20
Intercom	ZB149	April 81	£19·25
Digital Rule	ZB148	April 81	£28·00
Freezer Alarm	ZB147	April 81	£11·75
LED Dice	ZB146	March 81	£7·50
Mini Siren	ZB145	March 81	£7·25
Modulated Tone Doorbell	ZB144	March 81	£6·25
Bench Power Supply	ZB143	March 81	£48·50
Car Actuated Driveway Light	ZB142	March 81	£22·00
3 Channel Stereo Mixer	ZB141	Feb. 81	£16·25
Signal Tracer	ZB140	Feb. 81	£7·50
Nicad Battery Charger	ZB139	Feb. 81	£12·00
Auto Slide Charger	ZB138	Jan. 81	£9·00
Ice Alarm	ZB137	Jan. 81	£7·25
Phaser Sound Effects	ZB136	Jan. 81	£23·30
Mini I.C. Radio	ZB126	Nov. 80	£10·35
Sound to Light	ZB127	Nov. 80	£19·00
Guitar Practice Amplifier	ZB128	Nov. 80	£16·85
Transistor Tester	ZB131	Nov. 80	£9·00
Soil Moisture Monitor	ZB132	Nov. 80	£5·00
Audio Effects Unit	ZB122	Oct. 80	£12·25
Phone Call Charge Jogger	ZB121	Oct. 80	£6·00
Darkroom Controller	ZB123	Oct. 80	£18·25
Bicycle Alarm	ZB124	Oct. 80	£9·25
TTL Power Supply Unit	ZB78	Sept. 80	£9·50
*TTL Logic Probe	ZB76	Sept. 80	£3·75
Bedside Radio	ZB74	Sept. 80	£14·75
Signal Tracer	ZB80	July 80	£5·50
Autowaa	ZB83	July 80	£19·75
A.F. Signal Generator	ZB84	July 80	£20·50
Auto Phase	ZB86	July 80	£19·75
Lights Warning System	ZB63	May 80	£4·00
Autofade	ZB66	May 80	£10·25
Cable and Pipe Locator	ZB54	March 80	£4·00
Micro Music Box	ZB45	Feb. 80	£17·50
Simple Short Wave Receiver	ZB44	Feb. 80	£19·50
Morse Practice Oscillator	ZB43	Feb. 80	£6·00
Slide/Tape Synchroniser	ZB42	Feb. 80	£11·50
Burglar Alarm	ZB51	Dec. 79	£5·50
Baby Alarm	ZB40	Nov. 79	£8·50
Chaser Light	ZB4	Sept. 79	£18·50
Simple Transistor Tester	ZB2	Sept. 79	£6·00
Varicap MW Radio	ZB1	Sept. 79	£8·50
Electronic Tuning Fork	ZB7	Aug. 79	£9·50
Warbling Timer	ZB5	Aug. 79	£6·30
Electronic Canary	ZB19	June 79	£5·00
Tremolo Unit	ZB18	June 79	£10·50
One Transistor Radio MW/LW	ZB104	March 79	£7·25
Micro Chime	ZB96	Feb. 79	£13·00
Lights Reminder for Car	ZB32	Jan. 79	£5·00
Fuzz Box	ZB106	Dec. 78	£6·75
Sound to Light	ZB112	Sept. 78	£7·00
Weird Sounds Effect Generator	ZB113	March 78	£6·00

TEACH-IN 82

All parts in stock.

List (1)	£19·75
List (2)	£10·50
Special Price List 1 and 2	£26·50

(A further £1 reduction on receipt of Vero Coupon from October issue valid only to 30/11/80.)

All Prices include Post & VAT
Callers Please Ring To Check Availability Of Kits

MAINS IONISER KIT ZD13

This negative ion generator gives you power to saturate your home or office with millions of refreshing ions. Without fans or moving parts it puts out a pleasant breeze. A pure flow of ions pours out like water from a fountain, filling your room. The result? Your air feels like fresh ocean air, pure crisp and wonderfully refreshing. All parts PCB and full instructions **£12·50.** A suitable case including front panel, neon switch, etc. Available at **£10·50.**

T. POWELL

ADVANCE WORKS,
44 WALLACE ROAD, LONDON N1
Tel: 01-226 1489
HOURS: Mon-Fri 9-5.30p.m. Sat 9-4.30p.m.

Minimum Telephone Orders £5·00
Minimum Mail Order £1·00

INTERESTED IN

ELECTRONICS?

TRY A ZEDPACK!

COMPONENTS AT A PRICE EVERYONE CAN AFFORD

Z1 **300** mixed ½ and ¼ **watt resistors** £1·95
Z2 **150** mixed **1 and 2 watt resistors** £1·95
Z3 **300** mixed **capacitors.** £3·95
Z4 **100** mixed **electrolytics** £2·20
Z5 **100** mixed **polystyrene caps** £2·20
Z6 **300** mixed **printed circuit components** £1·95
Z7 **300** mixed **printed circuit resistors** £1·45
Z9 **100** mixed miniature ceramic and **plate caps** £1·20
Z10 **25 assorted pots.** £1·50
Z11 **25** assorted **presets,** skeleton etc. £1
Z12 **20** assorted **vdr's** and **thermistors** £1·20
Z13 **1lb mixed hardware.** Nuts, bolts self-tappers, sleeving, etc. £1·20
Z14 **100** mixed, new and marked, full spec. **transistors.** Pack includes:— BC148, BF154, BF274, BC212L, BC238, BC184L, PBC108 and, or lots of similar types £4·95
Z15 **100** mixed **diodes** including:—zener, power, bridge, signal, germanium, silicon etc. All full spec. £4·95
Z16 **20** 1N4148 £1
Z17 **20** 1N4003/10D2 £1
Z18 **20** zeners, 1 watt and 400mw £1·50
Z19 12 ·125" TIL 209 RED. LED'S £1
Z20 10 Assorted **switches,** including push button, slide, multipole, miniature etc. **Fantastic value. £1·20.**

UHF MODULATORS
Video in UHF out. Calibrated to channel *36* (625 line UHF) housed in metal box 2¾" × 2" × ½" with 9' coaxial lead, TV plug and connection data. **£2·50** ea. **3 for £6.**

Aluminium finish *slider knobs*, standard fitting. **10** for **£1**

200μA Miniature level/batt. **meters,** as fitted to many cassette recorders. **90p**

Deluxe FIBREGLASS printed circuit etching kits.
Includes 100 sq ins. of copperclad F/G board. 1lb ferric chloride, (made for U.S. army to MIL, SPEC.), 1 dalo etch resist pen, abrasive cleaner, tweezers, etch resist dish and Instructions. **OUR PRICE £5·95**
1lb of FeCl. **£2·25.**

100 Miniature **reed switches.** £2·30
100 Subminiature Reed Switches. £4·20

10,000uf. 35v Tag ended. **20"** × **10"** diam. with fixing stud and nut. High quality. **£1** each, 3 for **£2·50.**

SMALL MAGNETS
With hole in **6** for **£1**

P/B SWITCH BANKS
These cost a fortune! Were made for various music centres. Includes independent and interdependent latching types multi pole c/o etc. Can be modified. Can't be repeated. **3 Banks for £1. KNOBS** for Switch Banks **10 for £1.** Chrome or spun aluminium finish.

MINIATURE MAINS TRANSFORMERS
Top quality. Split bobbin construction will give 4·5V-0-4·5V at 250MA. 1¾" × 1⅛" × 1⅓", all sorts of uses. **ONLY £1** 3 for **£2·50.**

PP3 Battery Connectors 10 for 50p.

Miniature Press to Make Switches, Red knob. **3 for 50p.**

Subminiature S.P.C.O. Slide Switches. **6 for 50p.**

Miniature D.P.C.O. Slide Switches. **6 for 50p.**

Standard **2P. 3 Position** Slide Switch. **4 for 50p.**

Loudspeaker, 2¼" Round 8 Ω. **60p** ea. **3** for **£1·50.**

Assorted Fuse Holders including 20mm, P.C., Panel and chassis types. **Pack of 7 for 50p.**

3·5mm Jack Sockets, switched. **Enclosed type.** P.C. or panel mounting. With nuts and washers. **4 for 50p.**

9 Section, **Chrome on Brass Telescopic Aerial.** Plugs into any 3·5mm socket. Approx 25" extended **£1** each. 3 for **£2·50.**

Hi Power **Infra Red Transmitter** 5mm LED. **TIL 38** 60p ea. **3** for **£1·50.**

Crystal Clear 3mm **LEDS very pretty** Red, Green, Yellow. 10 of one colour **£1.** 10 of each **£2·50.**

ALTERNATOR RECTIFIERS
Make lovely **60 amp** bridges. Ideal for **High Power Battery Chargers.** Type 4AFI. **Set of 4** (2 neg. case + 2 pos. case) **£2.**

Special Purchase enables us to offer **Mullard C280 Polyester Capacitors** (Liquorice Allsorts) at the unbeatable price of **£2 for 100 mixed.** These consist of factory clearance lots i.e. spillages, floor sweepings, cosmetic rejects etc. Also **Mullard miniature electrolytics 200 mixed £2.**

To: **"GEMINI ELECTRONIC COMPONENTS" DEPT EE**
"THE WAREHOUSE" SPEEDWELL ST. LONDON S.E.8.
Where shown. Send Cheque* or Postal Order. Plus **60p** P&P. and 15% VAT.
Please Quote ZED Code. *Schools etc. SEND OFFICIAL ORDER
ZED PACKS now available for **Callers** at 50 Deptford Broadway, London, S.E.8.

VARI WIPE

WIPER DELAY CONTROL

The Vari Wipe provides intermittent operation of the windscreen wipers with adjustable control to delay each wipe between 3 and 60 seconds. Set the control to suit the conditions to clear light drizzle, fog, snow, sleet or spray. Easily fitted to British, Continental & Japanese cars with 12 volt self park wipers. Complete kit contains all components, including timer chip, PCB, case, mounting panel, wire, etc., with full instructions.

VARI WIPE KIT £6.95 inc. P & P
ASSEMBLED £9.25 inc. P & P

or send large s.a.e. for details

Spimin DEVELOPMENTS

Dept EE 6

Card Holders Phone 0253 27244

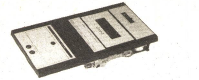
FREEPOST Thornton Cleveleys, Blackpool FY5 2BR

PLEASE MENTION

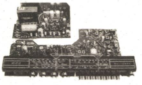
EVERYDAY ELECTRONICS

WHEN REPLYING TO ADVERTISEMENTS

B.K. ELECTRONICS—A SOUND CHOICE

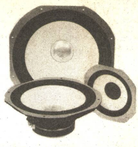


STEREO CASSETTE TAPE DECK MODULE
Full record and play-back facilities. Supplied as one complete unit for horizontal installation into cabinet or console of own choice. Brand new, ready built and tested. Smart silver and black finish. **Features:** Three digit tape counter, Auto stop, Six piano type keys, Record, Rewind, Fast Forward, Play, Stop and Eject. Automatic record level control. Main inputs plus secondary inputs for stereo microphones. **Input sensitivity** 100mV to 2V. **Output level** 400mV nominal. **Wow and flutter** 0·1%. Ideal for hi-fi, disco and computer applications etc. Easily connected. **Dimensions**—top panel 5½" × 11¼". Supplied complete with circuit and connecting diagrams. Power supply required—18V DC at 300mA. **PRICE £26·70** + £2·50 post and packing. Power supply kit (including transformer) £3·00.



G.E.C. TUNER AMPLIFIER CHASSIS—AM/FM
Originally designed for installation into a music centre. Supplied as two separate fully built and tested units which are easily wired together. Circuit diagram and inter-connecting wiring diagram supplied. **Rotary controls**—tuning, volume, balance, treble and bass. **Push button controls**—mono, tape, disc, A.F.C., F.M. (VHF), L.W., M.W., S.W. **Power output**—7 watts RMS per channel into 8 ohms. **Tape sensitivity** Output typically 150mV. Input 300mV. **Disc sensitivity** 100mV (Ceramic cartridge). **Stereo Beacon indicator** LED or bulb. **Dimensions**—Tuner 2¾" × 15" × 7½". Power amp. 2" × 7½" × 4½". **PRICE £23·50** + £2·50 post and packing.

NEW RANGE QUALITY POWER LOUDSPEAKERS (15", 12" and 8").
These loudspeakers are ideal for both hi-fi and disco applications. Both the 12" and 15" units have heavy duty die-cast chassis and aluminium centre domes. All three units have white speaker cones and are fitted with attractive cast aluminium (ground finish) fixing escutcheons.

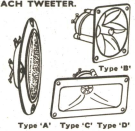


15" 100 watt R.M.S. Impedance 8 ohm, 2" aluminium voice coil. Resonant Frequency 20Hz. Frequency Response to 2·5KHz. **Price £32 each.** £2·50 Packing and Carriage each.

12" 100 watt R.M.S. Impedance 8 ohm, 2" aluminium voice coil. Resonant Frequency 25Hz. Frequency Response to 4KHz. **Price £23·70 each.** £2·50 Packing and Carriage each.

8" 50 watt R.M.S. Impedance 8 ohm, 1" aluminium voice coil. Resonant Frequency 40Hz. Frequency Response to 6KHz. **Price £8·90 each.** £1·25 Packing and Carriage each. Other units available.

PIEZO ELECTRIC TWEETERS—MOTOROLA
Join the Piezo revolution. The low dynamic mass (no voice coil) of a Piezo tweeter produces an improved transient response with a lower distortion level than ordinary dynamic tweeters. As a crossover **is not** required these units can be added to existing speaker systems of up to 100 watts (more if 2 put in series). **FREE EXPLANATORY LEAFLETS SUPPLIED WITH EACH TWEETER.**



Type 'A' 3in round with protective wire mesh. Ideal for bookshelf hi-fi speakers. **Price (Type 'A') £3·45 each.**
Type 'B' 3½in super horn. For general purpose speakers disco and PA systems, etc. **Price £4·35 each.**
Type 'C' 2in × 5in wide dispersion horn. For hi-fi systems and quality disco etc. **Price £5·45 each.**
Type 'D' 2in × 6in wide dispersion horn. Frequency response extending down to mid-range (2000 c/s) suitable for hi-fi systems and quality disco. **Price £6·90 each.**
Post and Packing, all types, 15p each (or SAE for Piezo leaflets).

B.K. ELECTRONICS

VISA

Dept. EE, 37 Whitehouse Meadows, Eastwood, Leigh-on-Sea, Essex SS9 5TY

★ SAE for current lists. ★ Official orders welcome. ★ All prices include VAT. ★ Mail order only. ★ All items packed (where applicable) in special energy absorbing PU foam. Callers welcome by **prior** appointment. Please phone 0702-527572

ELECTROVALUE

74LS00 series

74Ls-

00	14p	153	77p
02	14p	155	94p
04	16p	156	94p
05	23p	157	60p
08	20p	161	78p
10	19p	163	90p
11	20p	164	90p
14	58p	165	75p
20	18p	166	1.65p
30	21p	173	1.00p
32	22p	174	85p
37	24p	175	94p
38	35p	191	90p
42	59p	193	90p
47	89p	195	87p
51	25p	196	90p
73	30p	197	85p
74	30p	221	1·10p
75	44p	240	1·65p
76	30p	241	1·65p
85	80p	242	1·42p
86	38p	243	1·42p
90	44p	244	1·45p
92	59p	245	2·03p
93	57p	251	85p
107	40p	253	90p
112	38p	257	75p
123	82p	259	1·60p
125	45p	266	31p
126	42p	273	1·30p
132	60p	279	76p
136	42p	299	2·95p
137	1.10p	367	56p
138	64p	368	55p
139	70p	373	1·50p
145	1.20p	374	1·50p
148	1.65p	378	84p
151	77p	393	85p

Memories

Prime stock

2114	£2·40	2708	£3·00
4118	£7·90	2508	£3·50
4116 (200nS)	£1·50	2516	£3·50

(Above prices are net)

2508 and 2516 are single rail.

Z80 series

Z80 2·5MHz	£5·00	Z80PIO 4 MHz	£6·00
Z80A 4 MHz	£6·00	Z80 CTC	£6·00
Z80 PIO 2·5 MHz	£5·50	6402 UART	£4·50

(Above prices are net)

Special Offer

25 × 4116 each **£1·30 (£32·50 complete net)**

LOOK OUT FOR CATALOGUE 82
FREE *with Practical Electronics Nov. issue*

ORDERING
POSTAGE 40p on orders under £5·00
DISCOUNTS (Not on items marked Net or N)
5 % on orders over £20·00
10 % on orders over £50·00
Add V.A.T. at 15% to total value of order

ELECTROVALUE LTD. Dept. EE.10 28 St. Judes Road, Englefield Green, Egham, Surrey I W20 UHB.
Phone Egham 33603 (STD 0874 London 87). Telex 264475
Northern Branch (Personal Shoppers only) 680 Burnage Lane, Burnage, Manchester M19 1NA Phone (061) 432 4945.

PM COMPONENTS LTD

VALVE & COMPONENT SPECIALISTS
CONINGSBY HOUSE, WROTHAM RD.,
MEOPHAM, KENT. Dept. EE

BARCLAYCARD VISA

VALVES		PL508	1·48	6080	4·20	BC214	0·09	BU205	1·30
DY86	0·55	PL509	2·30	6146B	4·45	BC214L	0·09	BU208	1·39
DY802	0·60	PL802	2·50	7025	1·50	BC237	0·09	BU208A	1·52
E180F	5·25	PY88	0·74	7360	7·50	BC238	0·08	MJE340	0·40
EABC80	0·56	PY500A	1·35	7591	2·35	BC307	0·09	OC71	0·22
EBF89	0·70	PY801	0·65			BC327	0·10	R2008B	1·70
ECC81	0·55	QQV02/6	10·50	**SEMI-CONDUCTORS**		BC337	0·10	R2010B	1·70
ECC82	0·55	QQV03-20A				BC461	0·30	R2540	2·48
ECC83	0·60		12·25	AC126	0·22	BC478	0·20	TIP29	0·40
ECC85	0·60	QQV06-40A		AC127	0·22	BC547	0·10	TIP29C	0·42
ECC88	0·65		13·95	AC128	0·28	BC548	0·10	TIP30C	0·43
ECC807	1·30	QV03-12	3·50	AC141K	0·34	BC549A	0·08	TIP31C	0·42
ECF80	0·65	TY2-125A	45·00	AC176	0·22	BC557	0·07	TIP32C	0·42
ECF82	0·60	U19	11·95	AC176K	0·31	BC558	0·07	TIP41C	0·45
ECH81	0·58	UCH81	0·65	AC187	0·26	BD131	0·32	TIP42C	0·47
ECL82	0·58	UCL82	0·76	AC187K	0·28	BD132	0·35	TIP47	0·65
ECL83	1·13	UL84	0·78	AC188	0·22	BD133	0·40	TIP2955	0·84
ECL86	0·74	UY85	0·70	AD149	0·70	BD135	0·30	TIP3055	0·60
EF37A	3·60	Z759	9·00	AD161	0·39	BD136	0·30	TIS91	0·20
EF80	0·48	2D21	0·95	AD161/2	1·04	BD137	0·28	2N3054	0·59
EF86	0·70	2K25	10·00	AD162	0·39	BD138	0·30	2N3055	0·59
EF89	0·75	4CX2508	26·60	AF127	0·32	BD139	0·32	2N3702	0·12
EF91	1·22	5U4G	0·85	AF139	0·42	BD140	0·30	2N3703	0·12
EF93	0·65	6CD6GA	4·00	AF239	0·42	BD144	1·20	2N3704	0·12
EF94	0·55	6GK6	2·50	BC107	0·10	BF115	0·35	2N3705	0·12
EF95	0·78	6J6	0·65	BC107B	0·10	BF167	0·24	2N3706	0·12
EF183	0·56	6JS6C	2·55	BC108	0·10	BF179	0·34	2N3708	0·12
EF184	0·56	6KD6	3·95	BC108C	0·10	BF180	0·29	2N5294	0·38
EL34	1·54	6L6GC	1·75	BC109B	0·10	BF183	0·29	2N5296	0·48
EL84	0·60	6LD20	0·60	BC140	0·31	BF194	0·11	2N5298	0·38
EM84	0·70	6SN7GT	0·69	BC141	0·25	BF195	0·11	2SC1306	1·25
EZ80	0·56	6V6GT	0·90	BC142	0·21	BF196	0·11	2SC1307	1·85
EZ81	0·56	7S7	2·00	BC143	0·24	BF197	0·11		
GZ32	0·85	12AT7	0·55	BC147	0·09	BF198	0·10	**I.C.'s**	
GZ33	3·25	12AU7	0·60	BC148	0·09	BF199	0·14	MC1307	1·00
GZ34	2·00	12AX7	0·55	BC149	0·09	BF200	0·30	MC1350	1·00
KT61	3·50	12BA6	0·80	BC157	0·10	BF257	0·28	MC1495	3·00
KT66	4·95	12BE6	1·05	BC158	0·09	BF258	0·25	SN76003N	1·65
KT77	5·00	12BH7	0·95	BC159	0·09	BF259	0·26	SN76023N	1·35
KT88	6·00	12HG7	3·25	BC160	0·28	BF336	0·34	SN76033N	1·35
N78	8·90	30FL2	0·95	BC170B	0·10	BFX29	0·30	SN76131N	1·30
OA2	0·60	85A2	1·20	BC171	0·08	BFX84	0·26	SN76227N	1·05
PCF80	0·70	90C1	1·69	BC172	0·09	BFX85	0·28	SN76660N	0·60
PCF802	0·72	807	1·09	BC173B	0·10	BFX86	0·30	TA7205AP	1·95
PCF808	1·48	811A	9·00	BC182	0·09	BFX88	0·25	TAA661B	1·20
PCL82	0·74	813	11·30	BC183	0·09	BFY50	0·21	TBA120S	0·70
PCL84	0·76	833A	47·85	BC184LA	0·09	BFY51	0·21	TBA540	1·25
PCL86	0·76	866A	3·00	BC212	0·09	BFY52	0·25	TBA5500	1·55
PCL805	0·80	2050A	3·90	BC212L	0·09	BFY90	0·73	TDA1004A	2·20
PFL200	1·13	5763	3·20	BC213	0·09	BU105	1·22	UPC575C2	2·95
PL504	1·20	5814A	2·75	BC213L	0·09	BU108	1·69	TA7205P	1·95
								TBA810S	1·60
								UPC566H	2·95
								UPC1031H	3·95
								UPC1025	2·50
								UPC1156H	2·15
								UPC13635C	3·95

P. & P. 50p per order.
Prices exclude VAT. Please add 15%.
Phone 0474 813225
24 hour Ansaphone service

Many other types available.
Full price list available.
Callers welcome.
Monday to Friday 9.30-5.30
Saturday 9.30-12.00

CLASSIFIED

The prepaid rate for classified advertisements is 28 pence per word (minimum 12 words), box number 60p extra. Semi-display setting £7·24 per single column centimetre (minimum 2·5cm). All cheques, postal orders, etc., to be made payable to Everyday Electronics and crossed "Lloyds Bank Ltd." Treasury notes should always be sent registered post. Advertisements, together with remittance, should be sent to the Classified Advertisement Manager, Everyday Electronics, Room 2337, IPC Magazines Limited, King's Reach Tower, Stamford St., London SE1 9LS. (Telephone **01-261 5918**).

Receivers and Components

TURN YOUR SURPLUS capacitors, transistors etc., into cash. Contact Coles Harding & Co., 103 South Brink, Wisbech, Cambs. 0945 4188. Immediate settlement.

VEROBOARD. 0·1 stripboards average size 3½in x 5in, 25p each. Orders to Alco Electronics, 5 Sharon Road, Westend, Southampton.

300 SMALL COMPONENTS. Transistors, diodes £1·60. 7LBS ASSORTED COMPONENTS £3·95. 10lbs £5·25. FORTY 74 series ICs on panel £1·60. 500 capacitors £3·00. List 20p refundable. Post 50p optional insurance 20p. J. W. B. Radio, 2 Barnfield Crescent, Sale, Cheshire M33 1NL.

100 MIXED ICs—Transistors-Diodes £2·25. Lists 25p. Sole Electronics, E/E, 37 Stanley Street, Ormskirk, Lancs L39 2DH.

For Sale

NEW BACK ISSUES OF "EVERYDAY ELECTRONICS". Available 85p each Post Free, cheque or uncrossed PO returned if not in stock. BELL'S TELEVISION SERVICES, 190 Kings Road, Harrogate, Yorkshire. Tel: (0423) 55885.

SILICON SOLAR CELLS 4in diameter, 1·5A at 0·45V £10·18 inc VAT. We also stock other sizes of cells and batteries also Solar Panels, Science Kits, Fresnel Lenses, Stirling Engines, Cardboard Computer Kits, Energy Books, Space Blankets. Send 50p for lists. Edencombe Ltd, 34 Nathans Road, North Wembley, Middlesex HA0 3RX.

SECONDHAND ELECTRONIC TEST equipment including oscilloscopes, generators, psu's. NORFAB PLANT AND MACHINERY. Telephone Potter Heigham (069-27) 721.

EVERYDAY ELECTRONICS Vols 1 and 2 1971 to 1973 bound. Offers to M. Scivier, 8 Bucknill's Close, Epsom, Surrey.

Veteran & Vintage

"SOUNDS VINTAGE"

The only magazine for all vintage sound enthusiasts, packed with articles by top writers, covering gramophones, phonographs, 78s, wireless, news, history, reviews, etc.

All back-numbers to No.1 available.
Send 75p for sample copy.

28 Chestwood Close, Billericay, Essex

Books and Publications

OUT OF PRINT Book Service. 17 Fairwater Grove (E), Cardiff. Send S.A.E. for details.

PARAPHYSICS JOURNAL (Russian translations): Psychotronic Generators, Kirlianography, gravity lasers, telekinesis. Details: SAE 4in x 9in: Paralab, Downtown, Wilts.

MUSIC MAKER. Typewriter Keyboard replaces piano type. Amateur organ builders send £1·00 for your copy—post free—"QWERTONIC MUSICAL KEYBOARD" a new book by P. G. Roche to 71 Elmfield Avenue, Teddington, Middx TW11 8BX.

Service Sheets

Any single service sheet £1/L.S.A.E. Thousands different Repair/Service Manuals/Sheets in stock. Repair data your named T.V. **£6** (with circuits **£8**). S.A.E. Newsletter, Price Lists. Quotations.

AUSEE, 76 CHURCHES,
LARKHALL, LANARKSHIRE
(0698 883334).

BELL'S TELEVISION SERVICE for service sheets on Radio, TV etc. £1 plus SAE. Colour TV Service Manuals on request. SAE with enquiries to BTS, 190 King's Rd. Harrogate, N. Yorkshire. Tel: 0423 55885.

OSCILLOSCOPE repair and calibration. Quick service, competitive rates. W. I. R. Electronics, 01-567 6816.

Software

NEW—ZX80/ZX81 Programmable Character Generator. Built £34·50. Keyboard Kit £19·50, built £25. Memory Expansion £9·95. UK101/Superboard P.C.G. Kit £39·95, built £45·50. S.A.E. for details. Haven Hardware, 4 Asby Road, Asby, Workington, Cumbria.

SIXTY-FIVE ZX81 PROGRAMS. Listing only £4·95, Barclaycard accepted. Includes many games, utility programs, home finance, maths, chequebook, plus more. Includes hints'n'tips, from SUSSEX SOFTWARE, Wallsend House, Pevensey Bay, Sussex.

Educational

COURSES—RADIO AMATEURS EXAMINATION. City & Guilds. Pass this important examination and obtain your G8 licence, with an RRC home study course. For details of this, and other courses (GCE professional examinations etc), write or phone: THE RAPID RESULTS COLLEGE, Dept JR1), Tuition House, London SW19 4DS. Tel: 01-947 7272 (Careers Advisory Service).

Miscellaneous

BALLARD'S OF TUNBRIDGE WELLS have moved to 54 Grosvenor Road. No lists. SAE. All enquiries phone T/Wells 31803.

EVERYDAY ELECTRONICS P.C.B's
Drilled 1·5mm Glassfibre Fry's Roller Tinned

JULY 81	Xenon strobe lamp **£2·75**
AUG 81	Wheel of fortune set of two **£3·69**
SEP 81	Model train control **£1·58**
	Dice **£1·13**

For full list and current pcb's send SAE. Pcb's also produced to customers own masters. Trade enquiries welcomed. Write for quote.

CWO Please. Postage. Add **35p** postage and packing to complete order, Europe **70p**.

PROTO DESIGN, 14 DOWNHAM RD., RAMSDEN HEATH, BILLERICAY, ESSEX, CM11 1PU
Telephone 0268-710722

HEATHKIT continuing education ET-3100 trainer, also Sinclair DM 235 digital multimeter, both new. Offers to 57 Ballaghmore Road, Portballintrae, Co Antrim, N. Ireland.

ORDER FORM PLEASE WRITE IN BLOCK CAPITALS

Please insert the advertisement below in the next available issue of Everyday Electronics for .... insertions. I enclose Cheque/P.O. for £..............................

(Cheques and Postal Orders should be crossed Lloyds Bank Ltd. and made payable to Everyday Electronics)

NAME ....

ADDRESS ....

....

Company registered in England. Registered No. 53626. Registered Office: King's Reach Tower, Stamford Street, London SE1 9LS.

Send to: Classified Advertisement Manager

EVERYDAY ELECTRONICS
Classified Advertisements Dept., Room 2337,
King's Reach Tower, Stamford Street, London SE1 9LS.
Telephone 01-261 5918

Rate:
28p per word, minimum 12 words. Box No. **60p** extra.

DIGITAL WATCH BATTERY REPLACEMENT KIT

These watches all require battery (power cell) replacement at regular intervals. This kit provides the means. We supply eyeglass, non-magnetic tweezers, watch screwdriver, case knife and screwback case opener, Also one doz. assort. push-pieces, full instructions and battery identification chart. We then supply replacement batteries—you fit them. Begin now. Send £9 for complete kit and get into a fast growing business. Prompt despatch.

BOLSTER INSTRUMENT CO. (EE31)
11 Percy Avenue, Ashford, Middx., TW15 2PB

CABINETS chassis panels etc to your requirements. Send drawing for quote, enthusiast or trade. 8 Park Vale Close, Castle Hedingham, Halstead, Essex.

RECHARGEABLE BATTERIES

PRIVATE OR TRADE ENQUIRIES WELCOME

FULL RANGE AVAILABLE. SAE FOR LISTS. £1·45 for Booklet "Nickel Cadmium Power" plus catalogue. Write or call, Sandwell Plant Ltd, 2 Union Drive, Boldmere, Sutton Coldfield, West Midlands. 021-354 9764.

★ NEW SEALED LEAD RANGE NOW AVAILABLE ★

GOVERNMENT SURPLUS open seven days. Five acre depot. Millions of consoles, cabinets, components, receivers, meters, transformers, cable etc. No lists, stock constantly changing. Come and browse. Anchor Electronics, Eastwood, Nottingham. Tel: Langley Mill (07737) 67281.

DIGITAL WATCH SPARES. Standard parts for all LCD watches. Send SAE for full list. Profords, Copners Drive, Holmer Green, Bucks.

THE SCIENTIFIC WIRE COMPANY

PO Box 30. London E.4. 01 531 1568.

ENAMELLED COPPER WIRE

SWG	1 lb	8 oz	4 oz	2 oz
8 to 29	2·76	1·50	0·80	0·60
30 to 34	3·20	1·80	0·90	0·70
35 to 39	3·40	2·00	1·10	0·80
40 to 43	4·75	2·60	2·00	1·42
44 to 47	5·90	3·40	2·39	2·00
48 to 49	15·96	9·58	6·38	3·69

SILVER PLATED COPPER WIRE

14 to 30	6·50	3·75	2·20	1·40

TINNED COPPER WIRE

14 to 30	3·85	2·36	1·34	0·90

Prices incl. P & P vat. Orders under £2 add 20p. SAE for List of Copper/Resistance wire. Dealer enquiries welcome.

Registered Office 22 Coningsby Gardens.

PRE-PACKED. Screws, nuts, washers, solder tags, studding. Send for price list. A1 SALES (EE), PO Box 402, London SW6 6LU.

PROFESSIONAL DIGITAL STOPWATCH

★ 1/100 sec quartz accuracy—lap & total times

★ BIG ⅜" Liquid Crystal Display

★ PLUS—clock/calendar—month; date; day; hrs; mins; secs

★ Approx 3" × 2½" × ¾"

★ Consult the clock/calendar at any time without disturbing the stopwatch timing

£16·95 VAT & post paid

H. M. WHEELER & CO.
15 Hawthorn Crescent,
Bewdley, Worcs. DY12 2JE

PLASTIC BOXES

Size (mm)	Styrene Col. Black	ABS Plastic Col. Orange, Blk., Blue, Grey	
		Col. met. Lid	Clear Lid
85 × 56 × 35	55	92	102
100 × 51 × 25	51	85	94
112 × 62 × 31	60	101	111
121 × 65 × 39	81	135	149
150 × 80 × 39	97	162	178
190 × 110 × 60	176	293	322

ALUMINIUM DIE CAST BOXES
with Flanged Ltd—Natural Finish

Size (mm)	Price
91 × 38 × 25	112
109 × 58 × 25	122
116 × 91 × 28	166
116 × 91 × 51	191
185 × 119 × 51	323
185 × 119 × 76	337
185 × 185 × 64	675
50 × 51 × 25	105

All Prices in pence. Terms: C.W.O. Add VAT @ 15% on total order. Add 30p p & p.
Full Coloured Brochure of Boxes and Consoles, send 50p.

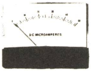
E. A. HUDSON
'SOUTHWAY', THORPE GREEN,
THORPE MORIBUX, BURY ST. EDMUNDS,
SUFFOLK IP30 0MZ

LEARN
ELECTRONICS WITHOUT SOLDER

Build electronic circuits without solder on a Roden S-Dec. This has built-in contacts and holes into which you plug your components. Suitable for all ages. Can be used time after time. Ideal gift for students or experimenters. Full instructions and 2 circuit diagrams with each S-Dec.

Send cheque or P.O. to:-
Roden Products, Dep EE
High March, Daventry,
Northants, NN11 4QE.

£3.85 plus 40p p.&p. each



METERS: 110 × 82 × 35mm
30μA, 50μA, 100μA. **£6·10.**
Post 50p.

METERS: 45 × 50 × 34mm
50μA, 100μA, 1mA, 5mA, 10mA, 5A. **£3·42.** Post 30p.

METERS: 60 × 47 × 33mm
50μA, 100μA, 1mA, 5mA, 10mA, 100mA, 1A, 2A, 5A, 25v, 50v, 50-0-50μA, 100-0-100μA. **£4·76.**
VU meters. **£5·18.**
Post on above meters 30p.

MULTI-METER
7N 360TR
20,000 ohm/volt
RESISTANCE RANGES
X1, X10, X1K, X10K
£13·30
P.&P. 60p

TRANSFORMERS
240v Primary

3-0-3v	100mA	**82p**
6-0-6v	100mA	**87p**
6-0-6v	250mA	**£1·22**
12-0-12v	50mA	**92p**
12-0-12v	100mA	**£1·15**

Post on above transformers 48p.

9-0-9v	1A	**£2·05**
12-0-12v	1A	**£2·60**
15-0-15c	1A	**£2·80**
6·3v	1½A	**£2·05**
6-0-6v	1½A	**£2·50**

Post on above transformers 87p.

All above prices include V.A.T. Send 50p for new 1981 fully illustrated catalogue, S.A.E. with all enquiries. Special prices for quantity quoted on request.

M. DZIUBAS
158 Bradshawgate, Bolton
Lancs. BL2 1BA

MAIL ORDER ADVERTISING

British Code of Advertising Practice

Advertisements in this publication are required to conform to the British Code of Advertising Practice. In respect of mail order advertisements where money is paid in advance, the code requires advertisers to fulfil orders within 28 days, unless a longer delivery period is stated. Where goods are returned undamaged within seven days, the purchaser's money must be refunded. Please retain proof of postage/despatch, as this may be needed.

Mail order Protection Scheme

If you order goods from Mail Order advertisements in this magazine and pay by post in advance of delivery, EVERDAY ELECTRONICS will consider you for compensation if the Advertiser should become insolvent or bankrupt, provided:

(1) You have not received the goods or had your money returned; and

(2) You write to the Publisher of EVERYDAY ELECTRONICS summarising the situation not earlier than 28 days from the date you sent your order and not later than two months from that day.

Please do not wait until the last moment to inform us. When you write, we will tell you how to make your claims and what evidence of payment is required.

We guarantee to meet claims from readers made in accordance with the above procedure as soon as possible after the Advertiser has been declared bankrupt or insolvent.

This guarantee covers only advance payment sent in direct response to an advertisement in this magazine not, for example, payment made in response to catalogues, etc., received as a result of answering such advertisements. Classified advertisements are excluded.

BAKER 50 WATT AMPLIFIER **£69** Post £2

Superior quality ideal for Halls/PA systems. Disco's and Groups. Two inputs with Mixer Volume Controls. Master Bass, Treble and Gain Controls. 50 watts RMS. Three loudspeaker outlets 4, 8, 16 ohm. AC 240V (120V available). Blue wording on black cabinet.

BAKER 150 Watt AMPLIFIER 4 Inputs £89

DRILL SPEED CONTROLLER/LIGHT DIMMER KIT. Easy to build kit. Controls up to 480 watts AC mains. Printed Circuit, **£3**
DELUXE MODEL Ready Built. 800 watts **£4**

STEREO PRE-AMP KIT. All parts to build this pre-amp. 3 inputs for high medium or low gain per channel, with volume control and P.C. Board. Can be ganged to make multi-way stereo mixers. **£2·95**

SOUND TO LIGHT CONTROL KIT MK II

Complete kit of parts, printed circuit. Mains transformer. 3 channels. Up to 1,000 watts each. Will operate from 200MV to 100 watts signal source. Suitable for home Hi-Fi and all Disco Amplifiers. Cabinet extra £4·50. **£15** Post 95p

200 Watt Rear Reflecting White Light Bulbs. Ideal for Disco Lights. Edison Screw 75p each or 6 for £4, or 12 for £7.50.

MAINS TRANSFORMERS Primary 240V A.C.		POST
250-0-250V 70mA, 6·5V, 2A	**£4.50**	£2
250-0-250V 80mA, 6·3V 3·5A, 6·3V 1A	**£5.00**	£2
350-0-350V 250mA, 6·3V 4A C.T. 5V/6·3V 2A	**£14.50**	£2
300-0-300V 120mA, 2×6·3V 2A C.T.; 5V 2A	**£10.00**	£2
220V 45mA, 6·3V 2A	**£2.50**	£1
GENERAL PURPOSE LOW VOLTAGE		
Tapped outputs available		
2 amp 3, 4, 5, 6, 8, 9, 10, 12, 15, 18, 25 and 30V	**£6.00**	£2
1 amp 6, 8, 10, 12, 16, 18, 20, 24, 30, 36, 40, 48, 60	**£6.00**	£2
2 amp 6, 8, 10, 12, 16, 18, 20, 24, 30, 36, 40, 48, 60	**£9.50**	£2
3 amp 6, 8, 10, 12, 16, 18, 20, 24, 30, 36, 40, 48, 60	**£12.50**	£2
5 amp 6, 8, 10, 12, 16, 18, 20, 24, 30, 36, 40, 48, 60	**£16.00**	£2

		POST			POST
6V, 500mA	**£2.00**	80p	6-0-6V, 100mA	**£1.50**	80p
12V, 100mA	**£1.30**	80p	20V, 40V, 60V, 1a	**£4.00**	£2
12V, 750mA	**£2.00**	80p	12V, 3a	**£3.50**	£1
10-0-10V 2a	**£3.00**	£1.	10V, 30V, 40V, 2a	**£3.50**	£2
30V, 5a and 17V-0-17V, 2a	**£4.00**	£2	12V, 2a	**£3.25**	£1
			20V, 1a	**£3.00**	£1
0-5, 8, 10, 16V, ½a	**£2.50**	£1	20-0-20V, 1a	**£3.50**	£1
9V, 3a	**£3.50**	£1	25-0-25V, 2a	**£8.00**	£2
15-0-15V 2a	**£3.75**	£1	2 of 18V, 6a	**£11.00**	£2
30V, 2a	**£3.50**	£1	12-0-12V, 2a	**£3.50**	£1
30V, 1½a	**£3.30**	£1	9V, ½a	**£1.50**	80p

AUTO TRANSFORMERS 115V to 240V 500W				**£12.00**	£2
CHARGER TRANSFORMERS – RECTIFIERS					
6-12V-3a	**£4.00**	£2	6-12V-2a	**£1.00**	80p
6-12V-4a	**£6.50**	£2	6-12V-4a	**£2.00**	80p

R.C.S. LOUDSPEAKER BARGAINS

3 ohm. 6 × 4in., 5in., 7 × 4in. £1·50. 8 × 5in. £3·00. 6½in. £3·00 8in. £3·50 10in. £4·00. 12in. £4·50.
8 ohm. 2¾in. £1·50. 3in. £1·50. 5in. £1·50. 8in. £3·50. 12in. £4·50
16 ohm. 6 × 4in. £1·50. 5in. £1·50. 8in. £3·50. 12in. £4·50. 10 × 6in. £3·50. 25 ohm 3½in, 35 ohm 3in. £1·50.

R.C.S. LOW VOLTAGE STABILISED POWER PACK KITS 90-100 mA Post 75p **£2·95**

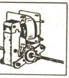
All parts and instructions with Zener diode printed circuit, rectifiers and double wound mains transformer input 200-240 a.c. Output voltages available 6 or 7.5 or 9 or 12V d.c. up to 100mA. State voltage.

PP BATTERY ELIMINATOR. BRITISH MADE Post 75p **£4·50**
Mains power pack 9 volt 400 ma stabilised, with overload cutout. Plastic case size 5 × 5¼ × 2¼. Suitable Radio/Cassettes. DELUXE Switched Model 3-6-7½-9V. 400ma **£7·50.**

THE "INSTANT" BULK TAPE ERASER
Suitable for cassettes, and all sizes of tape reels.
A.C. mains 200/240V.
Leaflet S.A.E. **£8** Post 95p

HEAD DEMAGNETISER PROBE £5·00

A.C. ELECTRIC MOTORS POST 75p.
2 Pole, 240V, ·2 Amp. Spindle – 1·43 × 0·212in. £1·75. 2 pole, 240V, ·15 Amp. Double spindle – 1·75 × 0·16in. Each £1. 2 Pole, 120V. ·5 Amp. Spindle – 0·75 × 0·2in. Two in series=240V. 50p each. Brush Motor. From a Food Mixer 240V, ·3 Amp. High Speed and Powerful. Spindle – 0·5 × 0.25in. £2·95



ALUMINIUM CHASSIS 18 s.w.g. Undrilled, 4 sides, riveted corners: 6 × 4 × 2½in. £1·20; 8 × 6 × 2½in. £1·50; 10 × 7 × 2½in. £1·90; 14 × 9 × 2½in. £2·50; 16 × 6 × 2½in. £2·40; 12 × 3 × 2½in. £1·50; 12 × 8 × 2½in. £2·20; 16 × 10 × 2½in. £2·70.
ALI ANGLE BRACKET 6 × ¾ × ¾in. 25p.
ALUMINIUM PANELS 18 s.w.g. 12 × 12in. £1·30; 14 × 9in. £1·20; 6 × 4in. 36p; 12 × 8in. 90p; 10 × 7in. 80p; 8 × 6in. 60p; 14 × 3in. 60p; 12 × 5in. 60p; 16 × 10in. £1·40; 16 × 6in. 90p.
ALUMINIUM BOXES, MANY SIZES IN STOCK.
4 × 2½ × 2in. £1.00; 3 × 2 × 1in. 80p; 6 × 4 × 2in. £1.30; 8 × 6 × 3in. £2.10 12 × 5 × 3in. £2.30; 6 × 4 × 3in. £1.60; 10 × 7 × 3in. £2.50.

HIGH VOLTAGE ELECTROLYTICS

8/800V	**£1·20**
16/500V	**75p**
32/500V	**75p**
50/500V	**£1·20**
220/450V	**95p**
8+16/450	**75p**
32+32/350V	**50p**
32+32/500V	**£1·80**
40+80/500V	**£2**
16+32+32/500V	**£2**

DE LUXE BSR HI-FI AUTOCHANGER

Stereo Ceramic Cartridge
Plays 12in., 10in., or 7in records Auto or Manual. A high quality unit 240V AC.
Size 13¼ × 11¼in.
Above motor board 3¼in.
Below motor board 2¼in.

£20 Post on All Decks £2.

BSR Single Player P207 cueing device, ceramic cartridge.	**£17**	post £2
Garrard Single Player 730 SP metal turntable, cueing device, Snake arm, Magnetic cartridge.	**£27.50**	post £2
BSR. C172. Slim arm. Metal Turntable Ceramic Head. Cueing Device Auto Stop	**£20**	post £2
BSR Auto Changer. 11in. Turntable. Budget price. Stereo ceramic, reliable unit, 3-speed.	**£17·50**	post £2
ISKRA. Disco Deck 3 speed stereo	**£9·95** or **£18 pair**	post free

Rapid Mail Order 65p minimum postage. Callers Welcome.
Barclay – Access – Visa. Lists 30p. Closed Wed.

Radio Components Specialists
337, WHITEHORSE ROAD
CROYDON, SURREY, U.K. TEL: 01-684 1665.

MAINS INTERCOM

NO BATTERIES NO WIRES
ONLY **£37.99** PER PAIR
+ VAT £5·70
+ P & P £1·95

The modern way of instant 2-way communications. Just plug into power socket. Ready to use. Crystal clear communications from room to room. Range ¼-mile on the same mains phase. On/off switch. Volume control, with 'buzzer' call and light indicator. Useful as inter-office intercom. between office and warehouse, in surgery and in homes.
Also F.M. 2 channel "touch" model **£55·95** per pair + VAT **£8·40** + P&P £2·15.

NEW AMERICAN TYPE CRADLE
TELEPHONE AMPLIFIER

£18.95
+ VAT £2·85
+ P & P £1·65

Latest transistorised Telephone Amplifier, with detached plug-in speaker. Placing the receiver on to the cradle activates a switch for immediate two-way conversation without holding the handset. Many people can listen at a time. Increase efficiency in office, shop, workshop. Perfect for "conference" calls: leaves the user's hands free to make notes, consult files. No long waiting, saves time with long-distance calls. On/off switch, volume control, Conversation recording, model at **£20·95** + VAT £3·15. P&P £1·65.

DOOR ENTRY SYSTEM

No house / business / surgery should be without a DOOR ENTRY SYSTEM in this day and age. The modern way to answer the door in safety to unwanted callers. Talk to the caller and admit him only if satisfied by pressing a remote control button which will open the door electronically. A boon for the invalid, the aged, and busy housewife. Supplied complete d.i.y. kit with one internal Telephone, outside Speaker panel, electric door lock release (for Yale type surface latch lock): mains power unit, cable (4 pairs) 50ft and wiring diagram. Price **£59·95** + VAT £9·00 + P&P £2·25. Kit with two phones **£69·95** + VAT £10·50 + P&P £2·45.

10-day price refund guarantee on all items
Access and Barclaycard welcome.

WEST LONDON DIRECT SUPPLIES EE 9
169 KENSINGTON HIGH STREET,
LONDON, W8 Tel: 01-937 5548

If you find an ad unacceptable, don't turn the page: turn to us.

Every week, millions of advertisements appear in the press, on posters and in the cinema.

Most of them comply with the rules contained in the British Code of Advertising Practice and are legal, decent, honest and truthful.

But if you find one that, in your opinion, is wrong in some way, please write to us at the address below.

We would like you to help us keep advertising up to standard.

The Advertising Standards Authority.
If an advertisement is wrong, we're here to put it right.
A.S.A. Ltd., Brook House, Torrington Place, London WC1E 7HN.

INDEX TO ADVERTISERS

Alcon 696
Ambit 687
Amtron.. 693
Audio Electronics .. Cov. II, 699

Bi-Pak 645
B.K. Electronics 709
B.N.R.E.S. 647, 646
Boss Industrial 642
Bull J. 643

C.B. Magazine 704
CHJ Supplies.. 704
Chordgate 642
Chromatronics 704

Dziubas M. 711

Electroni-Kit 699
Electronize Design 693
Electrovalue 709

Gemini 708
Greenweld 699, 701

Heath-Kit 644
Home Radio 702

Intertext (ICS) 702

Litesold 702

Magenta Electronics .. 700, 701
Maplin Electronic Supplies Ltd. Cov. IV
Marshalls 696
Micro Times 650
Mod Mags 702

OK Machine Tools 644

Phonosonics 703
PM Components 709
Pops Components 704
Powell T. 708

Radio Component Specialists .. 712
Radio TV Components 695
Rapid Electronics 642

Science of Cambridge .. 706, 707
Selray Book 649
Silica Shop .. .. .. Cov. III
Spimin Electronics 708

Teleman Products 687
Tempus 648, 649
Titan Transformers 649
T.K. Electronics 705

Vero Electronics 650, 651

Watford Electronics.. 641
West London Direct Supplies .. 712
Wilmslow Audio 693
Wireless World 705

Published approximately the third Friday of each month by IPC Magazines Ltd., Kings Reach Tower, Stamford St., London SE1 9LS. Printed in England by Index Printers, Dunstable, Beds. Sole Agents for Australia and New Zealand—Gordon and Gotch (A/Sia) Ltd. South Africa—Central News Agency Ltd. Subscriptions: Inland £9.00, Overseas £10.00 per annum payable to IPC Services, Oakfield House, Perrymount Road, Haywards Heath, Sussex. Everyday Electronics is sold subject to the following conditions namely that it shall not, without the written consent of the Publishers first given, be lent, resold, hired out or otherwise disposed of by way of Trade at more than the recommended selling price shown on cover, and that it shall not be lent, resold, or hired out or otherwise disposed of in a mutilated condition or in any unauthorised cover by way of Trade, or affixed to or as part of any publication or advertising, literary or pictorial matter whatsoever.

ELECTRONIC GAMES

COLOUR CARTRIDGE T.V. GAME

SEMI-PROGRAMMABLE T.V. GAME
+ 4 Cartridges + Mains Adaptor
Normal Price £73
NOW REDUCED TO: £39.50 inc. VAT

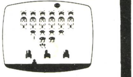
DATABASE T.V. GAME

FULLY PROGRAMMABLE CARTRIDGE T.V. GAME
14 Cartridges available
Normal Price £87.86
NOW REDUCED TO: £59 inc. VAT

ATARI T.V. GAME

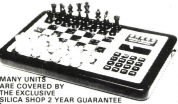
The most popular T.V. Game on the market with a range of over 40 cartridges including SPACE INVADERS with over 112 games on one cartridge. **£95.45** inc. VAT

SPACE INVADERS



Hand-held Invaders Games available **£19.95**
+ Invaders Cartridges available to fit *ATARI/RADOFIN/ACETRONIC/PHILIPS G7000*
+ Cartridges also available for *MATTEL/TELENG/ROWTRON/DATABASE/INTERTON*

CHESS COMPUTERS



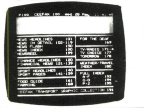
MANY UNITS ARE COVERED BY THE EXCLUSIVE SILICA SHOP 2 YEAR GUARANTEE

We carry a range of over 15 different Chess computers:

Electronic Chess	**£29.95**
Chess Traveller	**£39.95**
Chess Challenger 7	**£79.00**
Sensory 8	**£119.00**
Sensory Voice	**£259.00**

SPECIAL OFFERS:
VOICE CHESS CHALLENGER
Normal Price £245 **NOW £135.00**
SARGON 2.5/BORIS 2.5
Normal Price £273.70 **NOW £199.95**
All prices include V.A.T.

TELETEXT ADD-ON ADAPTOR £199 inc. VAT

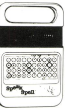


THE RADOFIN TELETEXT ADD-ON ADAPTOR

Plug the adaptor into the aerial socket of your colour T.V. and receive the CEEFAX and ORACLE television information services.

THIS NEW MODEL INCORPORATES:
- Double height character facility
- True PAL Colour
- Meets latest BBC & IBA broadcast specifications
- Push button channel change
- Unnecessary to remove the unit to watch normal TV programmes
- Gold-plated circuit board for reliability
- New SUPERIMPOSE News Flash facility

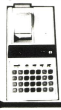
SPEAK & SPELL



Normal Price £49.95
NOW REDUCED TO: £39.50 inc. VAT

Teach your child to spell properly with this unique learning aid. Fully automatic features and scoring. Additional word modules available to extend the range of words.

ADDING MACHINE
OLYMPIA HHP 1010



Normal Price £57.21
NOW REDUCED TO: £34 inc. VAT

Uses ordinary paper! No need to buy expensive thermal paper!
Fast add listing PRINTER/CALCULATOR. 2 lines per second, 10 digit capacity. Uses normal adding machine rolls. Battery or mains operated.
Size 9¼"x4⅝"x2⅜"
(Mains adaptor extra)

24 TUNE ELECTRONIC DOOR BELL

Normal Price £19.70
NOW REDUCED TO: £12.70 inc. VAT

Plays 24 different tunes with separate speed control and volume control. Select the most appropriate tune for your visitor, with appropriate tunes for different times of the year!

MATTEL T.V. GAME

The most advanced T.V. game in the world 20 cartridges available. Add-on KEYBOARD coming soon to convert the MATTEL to a home computer with 16K RAM, fully expandable and programmable in Microsoft Basic. Other accessories will be available later in the year **£199.95** inc VAT

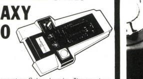
HAND HELD GAMES

EARTH INVADERS

These invaders are a breed of creature hitherto unknown to man. They cannot be killed by traditional methods — they must be buried. The battle is conducted in a maze where squads of aliens chase home troops. The only way of eliminating them is by digging holes and burying them. **£23.95** *inc. VAT*

HAND HELD GAMES

GALAXY 1000



The 2nd generation Galaxy Invader. The invaders have re-grouped and have a seemingly endless supply of spacecraft whilst the player's arsenal is limited to just 250 missiles to be launched from 3 missile stations. You have to prevent the invaders landing or from destroying your home defences. **£19.95** *inc. VAT*

THE OLYMPIA — POST OFFICE APPROVED
TELEPHONE ANSWERING MACHINE
WITH REMOTE CALL-IN BLEEPER

This telephone answering machine is manufactured by Olympia Business Machines, one of the largest Office Equipment manufacturers in the U.K. It is fully POST OFFICE APPROVED and will answer and record messages for 24 hours a day. With your remote call-in bleeper you can receive these messages by telephone wherever you are in the world. The remote call-in bleeper activates the Answer/Record Unit, which will at your command repeat messages, keep or erase them, and is activated from anywhere in the world, or on your return to your home or office. The machine can also be used for message referral, if you have an urgent appointment, but are expecting an important call, simply record the 'phone number' and location where you can be reached. With optional extra bleepers (£13 each) this facility can be extended to colleagues and members of the family. Using a C90 standard cassette you can record as many as 45 messages. The announcement can be up to 16 seconds long and the incoming message up to 30 seconds long.

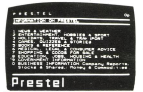
The machine is easy to install and comes with full instructions. It is easily wired to your junction box with the spade connectors provided or alternatively a jack plug can be provided to plug into a jack socket. Most important, of course, is the fact that it is fully POST OFFICE APPROVED.

The price of £135 (inc. VAT) includes the machine, an extra-light remote call-in Bleeper, the microphone message tape, A/C mains adaptor. The unit is 9¾"x6"x2½" and is fully guaranteed for 12 months. The telephone can be placed directly on the unit — no additional desk space is required.

EE 10

£135 *inc. VAT*

PRESTEL VIEWDATA

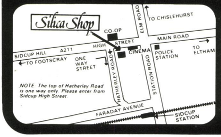

PRESTEL Op
INFORMATION ON PRESTEL
1 NEWS & WEATHER
2 ENTERTAINMENT, HOBBIES & SPORT
3 HOLIDAYS, TRAVEL & TRANSPORT
4 GAMES, QUIZZES & STORIES
5 BOOKS & REFERENCE
6 MEDICAL, LEGAL & CONSUMER ADVICE
7 SHOPPING & GOODS FOR SALE
8 EDUCATION, JOBS, HOUSING & HEALTH
9 GOVERNMENT INFORMATION
0 BUSINESS INFORMATION Company Reports, Stocks & Shares, Money & Commodities
Prestel

The ACE TELCOM VDX1000 Prestel Viewdata adaptor simply plugs into the aerial socket of your television and enables you to receive the Prestel/Viewdata service in colour or black & white.

Features —
- Simplified controls for quick, easy operation
- Special graphics feature for high resolution
- State-of-the-art microprocessor controller
- Standard remote telephone keypad with Prestel keys * #
- Auto dialler incorporated for easy Prestel acquisition
- True PAL colour encoder using reliable IC — chroma filter and dela line incorporated for minimum picture interference/maximum fidelity
- Includes convenient TV — Prestel switchbox
- Easily connected to standard home or office telephone lines
- Fully Post Office approved

***SPECIAL PRICE* £228.85** *inc VAT*

FOR FREE BROCHURES – TEL: 01-301 1111



NOTE: The top of Hatherley Road is one way only. Please enter from Sidcup High Street

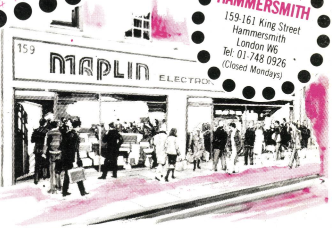
For free illustrated brochure and reviews on our range of electronic games, please telephone 01-301 1111. Free delivery service available. To order by telephone please quote your name, address and ACCESS$BARCLAYCARD number, and leave the rest to us. Post and packing Free of Charge. Express 48hr. delivery service available

- CALLERS WELCOME — Demonstrations daily at our Sidcup shop, open from 9am-6pm, Monday-Saturday (Early Closing Thursday 1pm — Late Opening Friday 8pm)
- 2 YEAR GUARANTEE — All goods are covered by a full year's guarantee and many are further covered by our exclusive Silica Shop 2 year Guarantee
- MONEY BACK UNDERTAKING — If you are unsatisfied with your purchase and return it within 7 days we will give you a full refund
- AFTER SALES SERVICE — Available on all machines out of guarantee
- COMPETITIVE PRICES — We are never knowingly undersold
- HELPFUL ADVICE — Available on the suitability of each machine
- CREDIT FACILITIES — Full credit facilities available over 12, 24 or 26 months at competitive rates of interest
- PART EXCHANGE SCHEME — available on second-hand machines
- CREDIT CARDS WELCOME — Access, Barclaycard, Diners Club, American Express

SILICA SHOP LIMITED
1-4 The Mews, Hatherley Road, Sidcup, Kent DA14 4DX
Telephone: 01-301 1111 or 01-309 1111

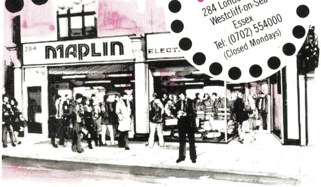
SILICA SHOP

MAPLIN make it easy...



in HAMMERSMITH

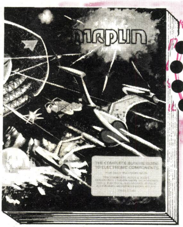
159-161 King Street
Hammersmith
London W6
Tel: 01-748 0926
(Closed Mondays)



in SOUTHEND

284 London Road
Westcliff-on-Sea
Essex
Tel: (0702) 554000
(Closed Mondays)

For personal service visit one of our stores. Our new store at Hammersmith is conveniently situated near the end of the M4 and the North and South Circular Roads. There is excellent street parking on meters a few steps away and Hammersmith Underground Station is nearby. Call in and see us soon.



in our CATALOGUE

320 big pages packed with data and pictures of over 5,500 items

Over 100,000 copies sold already!
Don't miss out on your copy.
On sale now in all branches WH Smith price £1.
In case of difficulty check the coupon below.

by MAIL ORDER

A fast service
You can rely on

- Same day service on in-stock lines
- Very large percentage of our stock lines in stock
- All prices include VAT
- Large range of all the most useful components
- First class reply paid envelope with every order
- Quality components—no rejects—no re-marks
- Competitive prices
- Your money is safe with a reputable company

On price, service, stock, quality and security it makes sense now more than ever to make MAPLIN your first choice for components every time!

make it easy... with MAPLIN

The Maplin Matinée

Amazing value for only £299.95 plus £99.50 for cabinet if required (carriage extra)

Easy to build, superb specification. Comparable with organs selling for up to £1,000. Full construction details in Electronics & Music Maker commencing March, 1981 issue. Back numbers available.

Post this coupon now.

Please send me a copy of your 320 page catalogue. I enclose £1.25 (incl. 25p p&p). If I am not completely satisfied I may return the catalogue to you and have my money refunded. If you live outside the U.K. send £1.68 or 12 International Reply Coupons.

Name____________________

Address____________________

EE/10/81

MAPLIN ELECTRONIC SUPPLIES LTD.

All mail to: **P.O. Box 3, Rayleigh, Essex SS6 8LR. Tel: Southend (0702) 554155 Sales: (0702) 552911**